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REPORT OF THE

BUREAU OF COMMERCIAL FISHERIES

FOR THE CALENDAR YEAR

1964

United States Department of the Interior
Fish and Wildlife Service
Bureau of Commercial Fisheries

UNITED STATES DEPARTMENT OF THE INTERIOR

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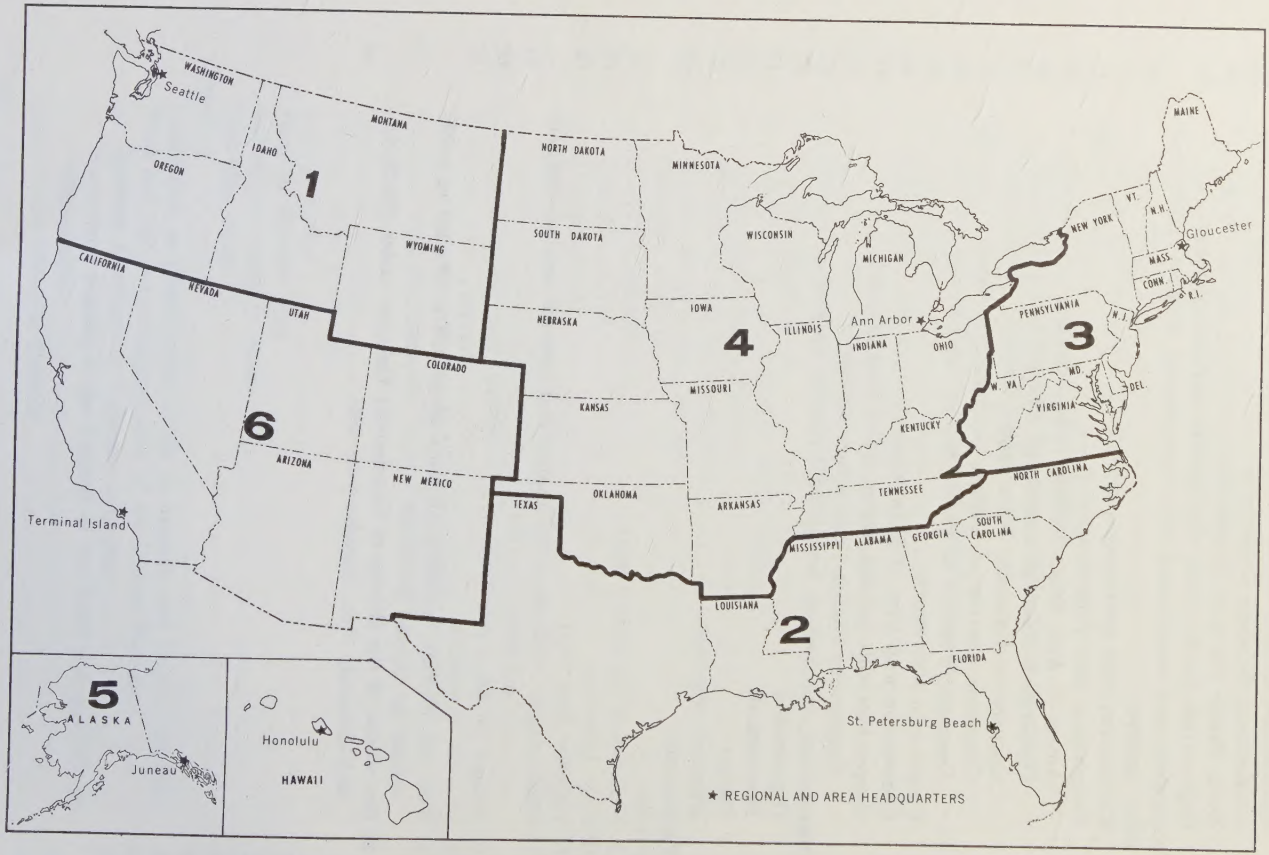

FRONTISPIECE.—Regional and area boundaries, Bureau of Commercial Fisheries, December 31, 1964.

Report of the Bureau of Commercial Fisheries for the Calendar Year 1964

This eighth annual report of the Bureau of Commercial Fisheries is made in compliance with Section 9(a) of the Fish and Wildlife Act of 1956. This Act created the U.S. Fish and Wildlife Service which comprises the Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife. This report includes the 10th annual report of the activities undertaken under the Saltonstall–Kennedy Act (app. H).

The fish and shellfish resources of the Nation materially increase the national income and food supply. These promote the health and well–being of the people and provide direct or indirect employment to a large number of them.

The fishing industry can increase the benefits resulting from these renewable resources by increasing the volume of its catches; however, it can do this only under favorable conditions. It must be free to seek new fishing areas, fish on the high seas according to international law, and develop methods, products, and markets in line with sound economic principles. Administrative or legal restrictions that conflict with or ignore economic needs should be removed. The fishing industry needs also an economic environment in which it can improve its production and processing and be protected from subsidized competing products. Other needs of the fishing industry are aids similar to those provided by the U.S. Government for other industries, such as better health standards and sanitation, fair trade standards, and good industrial and labor relations. The fishing industry also needs services to provide current information on production and trade, market promotion and development, and an extension service; research services for economic and technological development and resource conservation; and resource management to ensure the largest sustainable yield for the fisheries.

Trying to meet these needs of the fishing industry, the Bureau was

active in many fields in 1964. These activities included participation in international meetings, negotiation of treaties, and membership on commissions established by treaties to carry out their terms; extensive biological research on fish in laboratories, lakes, reservoirs, streams, and on the high seas; operation and maintenance of fish hatchery programs; fish passage and survival studies in river basins; exploratory fishing and gear development programs; technological research on fish nutrition and preservation and on fish oils; research on fish problems, such as disease, effects of pesticides on fish, pest and predator control; and management of the fur seal resources. In other services to the fishing industry, the Bureau collected information on foreign fishing activities and provided market news reporting of current market information on both domestic and foreign fishery commodities. It made economic and statistical surveys on producing, processing, distributing, and marketing fishery products and promoted the eating of more fish and shellfish through various marketing programs. The Bureau also aided the industry through a program for quality standards for fishery products and programs for financial assistance.

The interests of nations in the sea and in the uses of its resources has rapidly increased in the last few years. Foreign fishing fleets are searching the seas for new fishing areas; some are fishing in the waters off U.S. coasts. Since many foreign governments claim jurisdiction over fisheries off their coasts much farther than the 3 miles historically recognized by the United States they hamper longtime U.S. fisheries in those waters.

The Bureau considers oceanography as a means for solving problems of fishery resource conservation. The Bureau's goals in oceanography are to seek new information and understanding of the marine environment, which is so important in influencing the harvest of the valuable resources of the oceans. The Bureau's laboratory and vessel construction program complements the National Oceanographic Program, which is coordinated with development of oceanographic research by all U.S. Government agencies.

The United States continues to rely largely on imports of fish. From 1950 through 1962 our domestic catch of food fish gradually declined while our imports grew over 100 percent. In 1963 the imports of food fish declined and the percentage of the U.S. total supply of edible fishery products derived from imports remained about the same. In 1964 the U.S. domestic catch was less than the catches of 1962 and 1963.

As the population expands, the use of fishery products will increase also, and unless the United States is to rely on foreign nations for its fishery products, its domestic catch must be increased. To achieve this goal, Government help is being given the U.S. fishing industry through

the Fisheries Loan Program, the Fisheries Mortgage Insurance Program, and the Fishing Vessel Construction and Differential Subsidy Program. Other help that would be appreciated by the fishing industry is long–term low–cost, or even interest–free, loans to fishermen for constructing modern vessels that will meet strict standards on equipment and size; Government–financed training of fishermen; and further development of more efficient methods of catching and processing fish.

This report reviews briefly the Bureau's principal efforts in 1964 to help the fishing industry maintain the position of the United States, which is that of one of the world's leading fishing nations.

Condition and Trends of the Fisheries

The U.S. supply of fish and shellfish in 1964 (domestic catch and imports) was a record 12.0 billion pounds—5 percent more than in 1963. Imports (catch weight) accounted for 62 percent and the domestic catch 38 percent of the total. Nearly half the supply of edible fishery products came from imports, and over 70 percent of the fish received as industrial products, animal food, and bait (principally fish meal) was imported.

The commercial fisheries of the United States in 1964 yielded a catch of 4.5 billion pounds—about 325 million pounds less than in 1963 (app. A) and about 830 million pounds under the record 1962 production. Despite the decline in landings, fishermen received about $390 million for the catch—$13 million more than in 1963. The value of the catch was second only to the record $396 million received in 1962.

The decline in volume of the 1964 catch resulted from reduced production of menhaden, Atlantic sea herring, shrimp, tuna, Atlantic ocean perch, Pacific mackerel, and halibut. Pacific herring, salmon, blue crabs, king crabs, and haddock were taken in greater volume. The higher value of the catch resulted largely from increases in amounts paid fishermen for salmon, hard clams, and blue crabs. Despite sharp declines in landings of tuna and shrimp, the amount paid fishermen for these species was almost identical to that of 1963.

With a catch of 705 million pounds, Louisiana led the States, followed by California with 491 million pounds. In value of the catch to the fishermen, Alaska led with $57 million, followed by California with $50 million.

San Pedro, Calif., with landings of 346 million pounds valued at $32.5 million, was again the principal U.S. fishing port in both volume and value. Other leading ports in order of volume of fish landed were Pascagoula—Moss Point, Miss., Reedville, Va., Empire, La., and Cameron, La. Of these, all but San Pedro were entirely, or principally,

menhaden ports. New Bedford, Mass., again held second place in value of landings, followed by Boston, Mass., Brownsville—Port Isabel, Tex., and San Diego, Calif.

About 9 percent (411 million pounds) of the catch was taken on the high seas off foreign coasts. Landings from international waters were principally ocean perch and haddock taken off the east coast of Canada; shrimp off the east coast of Mexico; tuna off the Pacific coast of Central and South America; and troll-caught salmon, bottomfish, and halibut off British Columbia.

Menhaden (1,567 million pounds), salmon (353 million pounds), and tuna (305 million pounds) accounted for nearly 50 percent of the volume and 32 percent of the value of the 1964 catch. While the catch of clams, crabs, lobsters, oysters, scallops, and shrimp accounted for only 14 percent of the volume of the total catch, they provided 43 percent of the value. Shrimp, worth $70 million, was the most valuable item landed, followed by salmon, $58 million; tuna, $40 million; menhaden, $25 million; and northern lobsters, $19 million.

Imports of edible fishery products of the United States in 1964 far exceeded its exports. Its imports were a record 1.24 billion pounds (import weight) in 1964—75 million pounds more than in 1963. The gain resulted largely from increased imports of frozen tuna and groundfish blocks and slabs. Imports of nonedible fishery products were also up sharply because of an increase of nearly 63,000 tons of imported fish meal. Total imports of fish meal in 1964 were 439,143 tons compared with the domestic production of 235,252 tons. Exports of edible fishery products from the United States in 1964 totaled 90 million pounds—25 million pounds more than in 1963. The gain resulted from sale in Alaska of fresh salmon to Japanese interests for freezing and shipping to Japan for canning. Exports of domestic canned salmon, largely to the United Kingdom, increased. Nonedible exports declined sharply because of reduced shipments of fish oil to Europe.

The average wholesale price index for all fish and shellfish in December 1964 was 2.0 points higher than for December 1963, but 11.4 points less than in 1962, according to the U.S. Bureau of Labor Statistics' "Wholesale Average Price and Index for Edible Fishery Products."

Some highlights of the fisheries in 1964 were:

1. Alaska fishermen took a record 87 million pounds of king crabs—8 million pounds more than in 1963.

2. The record pack of canned tuna—17.7 million cases—was 671 thousand cases above the previous high packed in 1962.

3. Production of fish portions was a record 105.6 million pounds in 1964—nearly 11 million pounds more than in 1963.

4. Imports of groundfish and ocean perch fillets in 1964 were a record 246.6 million—77 percent of the supply (domestic production and imports) of these fillets.

5. Imports of fish meal in 1964 were a record 439,000 tons compared with the domestic production of 235,000 tons.

6. With fish and shellfish imports of 7.5 billion pounds (round-weight basis, excluding the weight of mollusk shells) worth almost $525 million, the United States continued to be the leading importer of fishery products.

7. With 6 percent of the world population, the United States consumed about 12 percent of the world catch in 1964.

8. Estimates of fishery resources available in waters in which U.S. fishermen operate indicate that if a profitable market existed, the annual domestic catch could be increased to about 22 billion pounds—4 times the 1964 production.

9. Maine fishermen received an average of 66 cents per pound for lobsters landed in 1964—a record high.

10. Although far below that of recent years, the menhaden catch of 1,567 million pounds, still accounted for 34.6 percent of the total catch.

Developments in the Fisheries

Developments in the domestic and foreign fisheries cause the catches of our fishermen to increase or decline, thereby affecting our national economy, the income of some of our people, and the food supply and well-being of all our people. Our Federal legislation tries to help the U.S. fishing industry achieve a higher level of production by providing funds for research and development of our fisheries and for improving our fishing fleet, prohibiting foreign fishing in our territorial waters, and providing medical care for certain vessel owners.

Domestic Fisheries

Developments in the fisheries may affect the fish and shellfish catches of our fishermen, causing the catches to increase at times and to decrease at other times. The discovery of new resources, expansion of fishing grounds, greater profit in the fishery, and favorable conditions of the stocks may enable the fishermen to increase their catches. New developments in fishing gear and improvements in other gear and their use by the industry usually result also in increased catches. Replacing outmoded vessels with new modern ones also improves the fishermen's chances of making large catches.

Several reasons, however, may cause the catches of our fishermen to decline. These may be depleted stocks from overfishing, failure of

a year class of fish, or voluntary cessation of fishing by fishermen. They may not fish for some species of fish and shellfish because of a lack of markets resulting from a change in people's food preference or because of competition of similar fish products.

Lack of technological progress hurts the U.S. industry. Failure to develop new fishing gear or improve existing gear and to build new and modern fishing vessels also adversely affects our fishing industry. The resulting low catches of fish and shellfish place our domestic industry in unfavorable competition with foreign fishing industries that use modern equipment and methods, which increase productivity at a lower cost of output per worker. Our fishing industry is at a disadvantage with the rest of the economy in this country and also with the economy of foreign countries that are exporting similar fish products to our markets.

Some of the developments in the fisheries in 1964 are listed here.

Fish Blocks

Although the quantity of fish blocks made from domestically produced fish is negligible, a large domestic industry processes and markets fish portions and fish sticks made from imported blocks. Toward the end of 1964, the supply of imported blocks became inadequate for the normal U.S. domestic demand. Some processors were forced to notify customers of temporary unavailability of some items, and prices on some products advanced sharply. The increased price and scarcity of some processed products can be adversely affected in the large school lunch program demand.

King Crab

The production of Alaska king crab was 86 million pounds in 1964—a record high. Additional new modern fishing vessels helped make this increased production. King crab meat has been marketed aggressively, and has wide acceptance by consumers, particularly in eastern markets.

Lake Trout

The number of juvenile lake trout in Lake Superior in 1964 was larger than that in 1963. This finding of Bureau biologists may be the beginning of the hoped–for results of the Great Lakes sea lamprey eradication program, which has as its purpose the reestablishment of a lake trout population that will support the valuable commercial fishery that once existed.

Menhaden

The catch of menhaden along the Atlantic Coast continued to decline during 1964. Only an estimated half billion pounds were taken, about 40 percent of the 1962 catch. This decline has resulted in near extinction for certain of the formerly productive fisheries. Most severely hit is the fishery in the Middle Atlantic area and specifically in Delaware Bay and adjacent waters. In the middle 1950's nearly two-thirds of the Atlantic Coast catch was taken in the Middle Atlantic area; in the early 1960's over three-fourths were taken from Chesapeake Bay. The bulk of the catch now comprises fish that are 2 years old or younger. Therefore, the old fish that were the principal support of the catches in the Middle and North Atlantic areas and which tended to stabilize violent fluctuations in abundance, are no longer present in significant numbers. Further, there have been no large year-classes of fish since 1958.

Menhaden Fish Meal

Because of the decreased catch of menhaden along the Atlantic Coast in 1964, the quantities available for processing into fish meal were smaller than in other years and the price of fish meal rose. Fish meal is an important ingredient in animal feeds, especially poultry feeds, in which the "growth factor" that fish meal provides is important in raising broiler chickens. Feed manufacturers buy large quantities of menhaden meal when its cost is low enough to be advantageous in their feed formulas; however, when the price of menhaden meal becomes too high, some feed manufacturers turn to other high-protein feed ingredients, such as soya bean material. This use of substitutes for ingredients other than menhaden meal creates an automatic natural ceiling on the price of menhaden meal even when the menhaden catch is low.

Pacific Hake and Sablefish

Exploratory fishery surveys of the Bureau's exploratory vessel *John N. Cobb* off the coasts of Oregon and Washington found extensive concentrations of Pacific hake in midwater during summer and fall. Large quantities of sablefish were also caught.

Pacific Ocean Perch

The *John N. Cobb* also located significant concentrations of Pacific ocean perch off the Washington Coast. They were in Continental Slope waters not previously fished by the commercial fleet.

Pink Salmon

The pack of 1.95 million cases of pink salmon in 1963 and 1.94 million cases in 1964 resulted in a large inventory buildup.

Sea Scallops

Production of sea scallops in New England (New Bedford, Mass.) was only 16,600,000 pounds—3.3 million pounds less than in 1963. Prices advanced through 1964 and reached an all-time high of 70¢ ex-vessel by November.

Tuna

A few instances of bacterially contaminated canned tuna in 1963 resulted in unfavorable publicity that drastically reduced sales of this product. The promotional efforts of the tuna industry and the Bureau, however, helped bring sales of canned tuna back to normal by late 1963. The 1964 domestic pack of 17,689,000 cases was a new record.

Federal Legislation

In 1964 the Congress passed four acts affecting the U.S. fishing industry (app. B). A summary of each act follows.

Commercial Fisheries Research and Development Act of 1964

The Act of May 20, 1964 authorizes the Secretary of the Interior to cooperate with the States through their respective State agencies in carrying out projects designed for research and development of the commercial fishery resources of the Nation. The Act provides for $5 million annually to be paid to the States, Puerto Rico, American Samoa, Virgin Islands, and Guam for the next 5 fiscal years. The funds will be apportioned according to the value of raw fish harvested by domestic vessels and received within each State plus the average value of the fishery products manufactured within each State. No State may receive an apportionment for any fiscal year of more than 6 percent of the total funds or less than 0.5 percent. The States will be required to provide matching funds equal to at least 25 percent of project costs. The Act also authorizes the allocation of $400,000 annually for 2 years and $650,000 for each of the following 3 years to States where there is a commercial fishery failure resulting from natural or undetermined causes; also the allocation of $100,000 a year for the next 5 fiscal years to States for developing new commercial fisheries; and loans (available up to June 30, 1966) to Alaska's fishermen to

charter fishing vessels for temporary replacement of vessels lost or damaged in the March 1964 Alaska earthquake disaster, with repayment to be made only from net profits after deducting a reasonable salary for fishermen chartering the vessels.

Medical Care for Vessel Owners

The Act of August 13, 1964 permits certain owners of fishing boats to receive medical care and hospitalization without charge at hospitals of the Public Health Service. Prior to 1954 self-employed fishermen were eligible for medical care in hospitals, out-patient clinics, and other medical facilities of the Public Health Service. An administrative ruling of that Agency in 1954 held that the term "employed" as used in the Public Health Service Act may not be reasonably interpreted as synonymous with "occupied" or "engaged in," but must be understood to refer to services rendered in an employee status under a contract of hire either expressed or implied. Subsequently, section 32.1(d) of the Public Health Service regulations (42 CFR sec. 32.1(d)) was amended to exclude the owner or joint owners of a vessel or the spouse thereof from receiving medical benefits. This amendment to the Act clearly provides inclusion of owner or joint owners of vessels (only of 5 net tons or more) and "self-employed" seamen among those eligible to receive medical benefits under the Act. Thus, the principal effect is to restore to self-employed fishermen the medical benefits they enjoyed prior to 1954.

Prohibition on Fishing in U.S. Territorial Waters

The Act of May 20, 1964 declares that it is unlawful for foreign vessels to engage in the fisheries within the territorial waters of the United States, its territories and possessions, and the Commonwealth of Puerto Rico, or within any waters in which the United States has the same rights in respect to fisheries as it has in its territorial waters, or to engage in the taking of any Continental Shelf fishery resource which appertains to the United States, except as provided by the Act or as expressly provided by an international agreement to which the United States is a party. Violators are subject to a fine of not more than $10,000 or imprisonment of not more than 1 year or both. Every vessel employed in any manner in connection with a violation of the Act shall be subject to forfeiture and all fish taken or retained in violation of the Act or the monetary value thereof shall be forfeited. Enforcement is the joint responsibility of the Secretary of the Interior, the Secretary of the Treasury, and the Secretary of the Department

in which the Coast Guard is operating; and such State and territorial offices as the Secretary of the Interior may designate. The Secretaries of the Treasury and Interior are authorized jointly or severally to issue such regulations as they determine necessary to carry out the provisions of the Act. "As used in this Act, the term 'Continental Shelf fishery resources' includes the living organisms belonging to sedentary species; that is to say, organisms which at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil of the Continental Shelf." The Act permits the Secretary of the Treasury, after giving 60 days' written notice to the President of the Senate and the Speaker of the House, to authorize a foreign vessel to engage in fishing for designated species in U.S. waters or within any waters in which the United States has the same rights in respect to fisheries as it has in its territorial waters, or for resources of the Continental Shelf which appertain to the United States. This permission is to be granted only after the Secretaries of State and Interior have certified that it would be in the national interest, and upon concurrence of "any State, Commonwealth, territory, or possession directly affected," and after a finding by the Secretary of the Interior that the country involved extends the same privileges to U.S. vessels. The Act permits the Secretary of State, with concurrence of the Secretaries of the Treasury and Interior, to grant permission to a vessel "owned or operated by an international organization of which the United States is a member, to engage in fishery research within the territorial waters of the United States . . . and to land its catch in a port of the United States, in accordance with such conditions as the Secretary may prescribe whenever they determine such action is in the national interest." The title of the amended bill was changed to read "An Act to prohibit fishing in the territorial waters of the United States and in certain other areas by vessels other than vessels of the United States and by persons in charge of such vessels."

United States Fishing Fleet Improvement Act

The Act of August 30, 1964 amends the Act of June 12, 1960, for correcting inequities in constructing fishing vessels and for other purposes. The Act makes it possible and practical to construct a new fishing fleet that will enable the United States to take its proper place in the fisheries of the world. It also extends the construction differential subsidy program to June 30, 1969, for fishing vessels of "advanced design"; authorizes an annual appropriation of not more than $10 million for a 5–year period; increases the subsidy from 33⅓ to 50

percent; provides that a subsidy be granted only after notice of hearing; and repeals certain restrictive provisions which limited the scope of that Act to a very small segment of the U.S. fishery. Vessels to be built under this program must be superior for utility and efficiency over a significant number of vessels fishing for the same species.

International Developments

Developments in the world fisheries, like those in the U.S. domestic fisheries, greatly affect the U.S. fishing industry and U.S. policies and programs. Competition of foreign countries for both high-seas fishery resources and domestic and foreign markets is a serious problem to the U.S. fishing industry. To help the industry solve these problems, the Bureau provides information on foreign fishery activities and developments for assessing their effect on the U.S. fishing industry and on U.S. policies and programs. The Bureau also participates in international meetings to guide wise harvesting of fishery resources and to protect the rights of U.S. fishermen; it enforces the treaties resulting from these meetings. The Bureau participates in trade and tariff negotiations to help form policies designed to move U.S.-produced fishery products in domestic and foreign markets. It also cooperates in international fishery programs that are beneficial to the Nation.

Developments in Foreign Fisheries

The world record catch of 51.4 million short tons was established in 1963 and continued the upward trend that began in the early 1950's. Complete data for the 1964 world catch are not available yet. The general increase in the world catch during the past decade has resulted from expanding fishery activities of Japan, Peru, and the U.S.S.R. In the last decade the U.S. catch has increased at a much slower pace than the world catch; consequently, the United States has dropped from second to fifth place among the leading fishing nations of the world, falling behind Peru, Japan, Communist China (estimated), and the U.S.S.R.

Japan and the U.S.S.R., which are technologically advanced countries, harvest fishery resources off U.S. coasts in the Northwest Atlantic and in the Bering Sea. Further, they are exploring almost every sector of the oceans in search of new fishery areas. Many new countries also are expanding their fishery activities.

In 1964 the United States and Japan had conflicts over fishery matters. They disagreed over the right to catch king crabs in the eastern Bering Sea. The United States asserted that the king crab is a creature of the Continental Shelf and that it has exclusive jurisdiction control

and right to use this fishery resource. The Japanese claimed that king crabs are a high-seas fishery resource. At a meeting of representatives of both countries in October and November 1964 in Washington, D.C., the two countries put aside their legal positions. Japan agreed to limit her catches of the king crab for 1965 and 1966 to the equivalent of 185,000 cases for each year. Both countries agreed to exclude from their catches female king crabs, soft-shelled crabs, and crabs with a carapace width of less than 14.5 centimeters (5.7 inches). They agreed also on the types of fishing gear to be used and established an area where only pots are to be used. Before December 31, 1966, they will meet again to reconsider the condition of the fishery and further regulations.

The United States and the U.S.S.R., on December 14, signed an agreement that was designed to minimize the damage that U.S.S.R. trawlers cause when their gear entangles with the pots of U.S. king crab fishermen in the Kodiak Island area of Alaska. After discussions in June 1964 at Juneau, Alaska, delegations of the two countries recommended the agreement to their governments. The agreement provides for establishing areas near Kodiak Island in which mobile gear (trawls) will not operate during July, August, September, and October. The agreement also established procedures for amending, by mutual agreement between the chief of the U.S.S.R. fishing fleet and local U.S. fishery officials, the boundaries of these areas or the periods during which they are reserved for fixed gear. It also provides for designating new areas to be covered by the mutual agreement.

The agreement establishes a system of direct radio communication between the U.S.S.R. fleet and U.S. fishery officials in Alaska. This system can be used for reporting to the U.S.S.R. fleet the positions of the U.S. king crab vessels outside the agreed-upon areas so that special precautionary measures can be taken to avoid damage to the U.S. gear.

The agreement further provides that the U.S.S.R. and the United States will begin special, cooperative research to develop more effective means of marking and detecting various types of fixed gear.

International Meetings

Bureau officials at international meetings helped solve numerous problems arising from expanding world fishery and trade activities. Decisions were reached on conserving fishery resources, collecting fishery statistics, handling and storing fish on fishing vessels, and prepackaging fishery products for retail sale.

The more important international meetings in 1964 were those of the Conference on International Traffic in Animals and Animal Prod-

ucts, Food and Agriculture Organization of the United Nations, Indo–Pacific Fisheries Council, Inter–American Tropical Tuna Commission, International Biological Program, International Council for the Exploration of the Sea, International Whaling Commission, North Pacific Fur Seal Commission, and Organization for Economic Cooperation and Development.

International Programs

The Food and Agriculture Organization (FAO) is responsible for United Nations Special Fund projects for fishery development for the Caribbean and Central America areas. The Bureau has been cooperating in the Caribbean project. In the fall of 1964 the Bureau's exploratory fishing vessel *Oregon* made the first of four cruises scheduled over the next 2 years in the Lesser Antilles area of the Caribbean Sea. Exploratory fishing with longline, trolling, trawls, and dredges were made in the general area between Barbados and Aves Island. Pelagic catches included small numbers of yellowfin and blackfin tuna, broadbill swordfish, dwarf herring, silversides, and several species of sharks. In addition, two schools of blackfin tuna were sighted off the east coast of St. Lucia. Brown, red, and striped shrimp, scarlet prawns, and lobsterettes also were caught during the cruise. The best catch was 120 pounds of red shrimp and 10 pounds of lobsterettes in a 60–minute drag north of Tobago Island.

Several United Nations observers and trainees from various countries in the survey area accompanied the *Oregon* during different parts of the cruise. The trainees learned of the availability of offshore fishery resources and exploratory fishing techniques that will be valuable in developing the commercial fishery of the Caribbean area.

The Bureau participated also in a United Nations Special Fund Mission study of how to improve the marine fishing industry of Brazil. To determine the most important problems retarding development of the fisheries, researchers traveled through the area, obtaining first–hand information and discussing problems with informed persons. The researchers then recommended revision of the laws, regulations, resolutions, decrees, and codes pertaining to fisheries to allow private investors to operate efficiently with modern vessels and equipment. The researchers recommended also the establishment of a Federal fishery administration.

Reporting on Foreign Operations

Expanding fishing activities by foreign countries have prompted the Bureau to obtain information needed to assess the impact of foreign

fishery activities and developments on the U.S. fishing industry and on Government programs and policies. Overseas fishery attachés in Denmark, Ivory Coast, Japan, and Mexico continued to supply the U.S. Government and the commercial fishing industry with news on fishery developments in their regions. Reports from the new post in West Africa contained valuable information on the rapidly expanding fisheries there. Current information on the world's ever-changing fisheries has provided a basis for many U.S. Government and industry decisions. Such reports are also used in international negotiations and in the resolution of international fishery problems.

As in 1963, the Bureau continued to provide current reporting on foreign fishing activities off U.S. coasts.

Trade and Tariff Negotiations

During 1964, the value of U.S. imports of fishery products totaled almost $525 million, a gain of about 7 percent over the previous record year 1963. The value of fishery exports was about $61 million, a gain of 8 percent. Exports have gained more than 70 percent since the low levels of 1962.

In May 1964, at the opening of the Kennedy Round negotiations in Geneva, members of GATT (General Agreement on Tariffs and Trade) agreed that import duties should be reduced up to 50 percent on all but a limited number of items that were excepted because of overriding national interest. As the year ended, negotiators were preparing to enter into confrontation exercises over the various items proposed for exception. The actual tariff bargaining sessions were expected to continue at least through 1965. Important features of this sixth tariff bargaining conference were the proposed across-the-board tariff cuts, the negotiation of nontariff barriers, and proposed special treatment for products of developing countries. The Bureau developed considerable data and background information for use in determining the economic effects of tariff adjustments on selected fishery products.

Treaty Enforcement and Foreign Fishing Surveillance

In 1964 the Bureau and the U.S. Coast Guard separately and cooperatively carried out enforcement activities and foreign fishing surveillance in the Northwest Atlantic Ocean, in the Bering Sea, and in the Gulf of Alaska to fulfill obligations imposed by international fishery conventions. They made extensive aerial and sea patrols. The Bureau helped the Coast Guard with the planning, provided qualified fishery management agents to accompany and assist all patrol craft, and made a limited sea patrol with a Bureau vessel.

The Bureau staff also participated with officials of the Departments of the Navy, State, and Treasury in an interagency study. Its purposes were to improve the efficiency of the enforcement of conventions on high seas fisheries and to obtain information on foreign fishing activities. This study stimulated the Bureau to make renewed efforts to develop new sources of information and improved methods of analyzing foreign fishing activities.

Accomplishments and Operations

Principal Accomplishments

The Bureau's accomplishments in 1964, like its activities, were many.

North Pacific

Alaska research.—In Alaska increased effort was directed to research on the estuarine survival of young salmon and the ecology that influences early marine growth and survival. Research on king crab and bottomfish also increased in response to an expanding domestic king crab fishery and a rapidly growing foreign trawl fishery for shrimp, ocean perch, and other demersal fishes.

The earthquake that shook central Alaska in the spring of 1964 resulted in important physical changes in many streams that provide spawning grounds for Prince William Sound pink salmon runs. Most of the salmon in this important production area spawn in intertidal stream sections. In shore areas of the Sound, stream sections were raised 5 or 6 feet, elevating them above tidal influence; in other areas they were submerged. The Biological Laboratory at Auke Bay began studying how returning adult salmon respond to these ecological changes and how productivity may be affected over a long period.

Columbia River Fishery Development Program.—The federally financed Columbia River Fishery Development Program completed its 16th year of operation in 1964. Administered by the Bureau of Commercial Fisheries, this Program is a cooperative endeavor among the five fish and game agencies of the States of Washington, Oregon, and Idaho, and the two Bureaus of the U.S. Fish and Wildlife Service. This Program continued the construction and operation and maintenance of screens and fishways, stream–improvement projects, and management technique studies. Twenty–one Program hatcheries were operated, and certain features at some hatcheries modified. Over 77.2 million fall chinook salmon, 7.8 million spring chinook, 24.2 million coho salmon and 0.5 million chum salmon, and 2.3 million steelhead trout, both fry and fingerlings, were released. In addition, Program hatcheries took

the eggs of over 116 million fall chinook, 7 million spring chinook, 52 million coho, 0.5 million chum, and 2 million steelhead.

The coho and fall chinook runs were quite large. The coho run into the Columbia River was the largest since Bonneville Dam was built in 1938; more than 50,000 cohos were counted as they passed over the Dam. This was three times greater than the number passing in the record year of 1941. More than 169,000 fall chinook passed through the fishways of Bonneville Dam, the greatest number since 1959.

The detailed evaluation of fall chinook hatchery production was continued, and about 8 million fingerlings were fin clipped and released at Program hatcheries. Total marked fish released through 1964 was about 23 million. An intensive mark recovery program in the sport and commercial fisheries from California to Alaska resulted in the recovery of 9,323 marked 2– and 3–year–old fall chinook during 1963 and 1964. Although full returns from the first year of marking are incomplete, the 1964 returns show that hatchery production contributed substantially to the fishery.

A survey in 1964 of the Indian fishery in the Bonneville pool area indicates that Indians took from the pool area about 941,000 pounds of salmon and steelhead; the salmon catch included about 28,000 fall chinook.

By the end of 1964, the Program completed 695 fish screens and 74 fishways, which were operating in Washington, Oregon, and Idaho. By 1964 some 1,700 miles of stream had been made readily accessible to migratory fish.

In late December 1964 the Pacific Northwest had some of the worst floods on record. Much of the damage occurred in the Columbia River area and affected the fishery resources. Several Program hatcheries were severely damaged, large numbers of screens in the John Day and Walla Walla Rivers were destroyed, and many tributary streams had severe log jams. Temporary measures helped restore the operations at many facilities.

Functional and structural plans and designs for fish passage facilities at Willamette Falls on the Willamette River, Oreg., were completed in 1964. As a result of a Federal Power Commission order, industrial water users at the Falls will pay a portion of the costs of building the fishways. These proposed fish facilities at Willamette Falls will make much of the Willamette River area accessible to fall chinook and coho, which now cannot pass over the Falls. In the expectation that fish passage conditions would be suitable at the Falls when the fish return as adults several years later, hatcheries have released large numbers of young salmon in the upriver area.

The study of management techniques is continuing to provide information that is pertinent to improvement of the ways in which the fish resources are managed. Of particular interest is the technique of marking fish by adding tetracycline drugs to their diet. The study of this technique, which makes a permanent, easily seen deposit in the bones, began in 1961 and now is almost finished. The Food and Drug Administration will probably approve the Bureau's request to use tetracycline, which will save time and money in migrant–marking programs. Studies were also continued on fish cultural methods and on controlled natural rearing of salmonids at the several natural and artificial impoundment areas.

Water–use development on the Pacific Coast is accelerating, as are the attendant problems. Many large–scale projects under construction, such as the High Mountain Sheep Dam on the Snake River, Dworshak Dam on the North Fork of the Clearwater River, and John Day Dam on the Columbia River, are making it difficult to manage the salmon and steelhead runs that use these streams. High dams with large reservoirs are particularly serious hazards to the passage of young downstream migrating salmon and steelhead. Artificial propagation facilities are being used as a partial solution for such developments. With the advent of Canadian water storage projects, additional problems are developing on the Columbia River, because stream flow will be regulated and changed water temperatures will occur. All these problem areas are being studied intensively.

Equipment for oceanography.—Oceanographic research programs are benefiting from recent technological advances. A new transponding, free–floating oceanographic buoy was successful in first tests. Later several buoys were released 300 miles off the Washington Coast and recovered as they approached the Coast. These buoys responded to radio signals from the Bureau research vessel *George B. Kelez* and provided radio–fixed locations for establishing drift direction and speed. The buoys are being equipped with pressure sensors and quartz thermometers to sample pressure and temperature to a depth of 984 feet. The sensors are inductively coupled to the cable, and their spacing and type may be varied as desired. All information will be digitally encoded at the sensors, tape recorded, and only transmitted upon receipt of proper radio signal; thus, temperature, pressure, and current drift and speed will be obtained at a considerable saving in vessel operating time and costs.

Exploratory fishing and gear tests.—In the summer and fall of 1964 off the Oregon and Washington Coasts the Bureau's vessel *John N. Cobb* found extensive concentrations of Pacific hake. The hake were distributed almost continuously from northern Washington to southern

Oregon in depths of 240 to 900 feet and were densely concentrated in the shallower end of this depth range off the northern Washington Coast. Echo sounding with high-resolution sonar equipment was used to locate the hake and estimate the sizes of the schools. The sonar gear detected hake only during daylight; the fish apparently disperse vertically during darkness and are not detectable as densely packed groups. Some schools were 25 miles long and 4 miles wide.

Besides exploratory surveys, the chartered 72-foot vessel *St. Michael* was used to test the efficiency of the "Cobb" pelagic trawl system in taking large volumes of hake. Catches during these tests averaged 18,000 pounds per 30-minute tow and were as high as 30,000 pounds per 30 minutes.

The *John N. Cobb* found large concentrations of sablefish and Pacific ocean perch off the Washington Coast in Continental Slope waters not previously fished by the commercial fleet. A series of tracklines were run off the Washington Coast to survey the bottom characteristics by echo sounding and to determine areas where experimental fishing was feasible. The suitability of the bottom for trawls was tested by dragging a snag cable or bottom trawl rigged with a snag cable over the area selected. Some drags at depths greater than 1,800 feet caught over 1,200 pounds of sablefish per hour. As high as 3,000 pounds of Pacific ocean perch per 1-hour drag were caught at depths of about 630 feet.

Fish Passage Program.—The emergency phase of the Fish Passage Program relating to proposed high dams in the Middle Snake River Basin in Oregon and Idaho was completed on schedule at the end of 1964. Results of these studies showed that adult salmon and steelhead can pass upstream through large stratified impoundments, but that young salmonids migrating downstream generally cannot. If runs are to be maintained in rivers above dams, young salmonids must be collected above reservoirs and transported below. Preliminary experiments with a traveling screen for guiding young fish into a collecting system have been highly successful and may solve the major problem of collecting young fish before they enter reservoirs. Improvements in turbine design and operation, turbine entrance design, and spillway construction promise to reduce significantly the loss of juvenile migrants passing through turbines or over spillways.

Fur seal harvest.—A commercial catch of 64,206 sealskins from the Pribilof Islands and 37,032 male and 11,567 female sealskins from St. Paul Island was taken. The females were harvested as a continuation of the program begun in 1956 to stabilize the size of the herds by harvesting females as well as males. St. George Island in 1964 had a production of 11,191 male sealskins and 4,416 female sealskins. The

total harvest on both Islands was 48,223 male and 15,983 female sealskins. Under terms of the Interim Convention on Conservation of North Pacific Fur Seals, the Governments of Canada and Japan each received 15 percent of the sealskins harvested.

In 1964, 62,655 sealskins, processed under the recently terminated contract with Fouke Fur Company, were sold for the account of the U.S. Government. Gross sales of these skins were $4,647,778 and netted the U.S. Treasury $2,879,321.

As in 1963, considerable time was spent in trying to reach an agreement on a new contract for processing and selling fur sealskins. The old contract held by the Fouke Fur Company was terminated December 31, 1962.

Fur seal resource management.—The Bureau continued to administer the fur seal industry of the Pribilof Islands and to provide care for the Aleut residents.

Services comparable to those performed by an Executive Director were again supplied to the North Pacific Fur Seal Commission during the interval between the Seventh Annual Meeting held in Moscow February 24 to 27, 1964, and the Eighth Annual Meeting to be held in Tokyo February 22 to 26, 1965.

Salmon serology.—Scientists at the Bureau's Biological Laboratory, Seattle, Wash., used the results of pioneering studies in serology, or blood group analysis, to identify subpopulations of salmon in the eastern North Pacific. For intelligent management and full use of the salmon resources, it is necessary to know when the subpopulations occur and how much they overlap or mix.

Shrimp and scallop explorations.—The Bureau's chartered vessel *Paragon* made trawl drags at 208 stations throughout the Gulf of Alaska and in selected sections of the Bering Sea. An abundance of pink shrimp and the larger side-stripe shrimp was found near Shumagin Islands in the Gulf of Alaska. The average catch rate from 82 half-hour tows in the Shumagin Island area in 1964 was over 650 pounds of pink shrimp. The side-stripe shrimp, taken also in Marmot Bay, east of Kodiak Island, averaged about 26 whole shrimp per pound. These explorations were designed to complete previous seasonal shrimp surveys in the northern portion of the Gulf of Alaska. During a 3-year period over 500 exploratory shrimp-trawl drags were made in the area.

A few drags for scallops were made in waters adjacent to Kodiak Island and along the Alaska Peninsula. Scallops were caught over a large area but not in commercial concentrations. The best single catch was about 250 6-inch scallops taken near Marmot Island.

Whale research.—U.S. whale research was greatly expanded in 1964. The first operational whale marking program began early in the year.

Under a scientific collecting permit issued by the Bureau, 20 gray whales were killed and data collected on their age, food habits, growth, reproduction, and the parasites associated with them. The United States, as a member of the International Whaling Commission, is cooperating with Canada, Japan, and the U.S.S.R. in studying whale stocks in the North Pacific. A four-nation research group, designated by the Scientific Committee of the Commission, will determine the condition of the whale stocks and provide a scientific basis for management.

Whale resource management and harvest.—Whale catching and land-processing operations of five companies in California and Oregon were licensed and inspected. These companies caught 274 whales of various species, including the 20 gray whales taken for research purposes. The remaining whales were processed, and their meat was sold primarily to fur animal ranchers.

California

Competition between sardine and anchovy.—Scientists at the Bureau's California Current Resources Laboratory, La Jolla, have a hypothesis for the great decline in California sardine abundance. They believe that its decline, which began about 1945, was due largely to a selective fishery on the sardine during a series of years when oceanographic conditions were unfavorable for its spawning success. These conditions, however, were so favorable to the dramatic increase in the anchovy population that the anchovy has filled the ecological niche once occupied by the sardine.

Oceanographic data collection.—Using automatic data processing methods, scientists prepared a historical series of sea temperature charts for the North Pacific. By means of monthly mean sea levels, they are exploring the relative significance of changes in ocean conditions (e.g., ocean currents) to the abundance and distribution of commercial fishes. After some 4 years of effort they have nearly completed a summary atlas of all oceanographic data for the Pacific; these records will be of vital interest to commercial fishermen and fisheries research scientists throughout the Pacific Basin.

Tuna studies.—Scientists at the Bureau's Tuna Resources Laboratory, La Jolla, are studying tuna behavior. Information on the response of tunas to light, sound, and temperature and on the histological and physiological nature of their sensory systems will help the scientists to solve two problems: the relation of underwater visibility to the avoidance of nets by tunas and the relation of the temperature structure of water to the success of fishing.

The Laboratory has completed a detailed analysis of economic factors affecting vessel operation in the West Coast tuna fishery.

Of particular value to U.S. tuna fishermen is the series of 24 topographic charts of the ocean floor of the eastern tropical Pacific completed in 1964. These charts, prepared by the Tuna Resources Laboratory and Scripps Institution of Oceanography, also at La Jolla, show the location of offshore banks and sea mounts.

Oceanographic studies of the rates of sea-water warming during early spring enabled tuna scientists to forecast the distribution and relative abundance of albacore and bluefin tuna in the eastern Pacific during the summer season.

Hawaii

Atlas of oceanographic data for the Pacific.—After 4 years of effort the Bureau's Biological Laboratory, Honolulu, has almost completed a summary atlas of all available oceanographic data for the Pacific. The atlas will be valuable to commercial fishermen and fishery research scientists throughout the Pacific Basin.

Tuna studies.—Through research on ocean currents the Bureau's Laboratory in Honolulu has improved its methods for predicting places and times of fish concentration. Since 1959, on the basis of changes in ocean circulation, the scientists have predicted annually the catch of the Hawaiian skipjack fishery. During 1964 the new research vessel, *Townsend Cromwell,* made monthly cruises in Hawaiian waters to obtain further information on the interrelations between skipjack tuna and the ocean environment.

Studies were made on the behavior of tunas. Information was gathered on their reaction to light, sound, and temperature and on the histological and physiological nature of their sensory systems.

Using the results of pioneering studies in serology, or blood group analysis, the Laboratory scientists identified subpopulations of tuna throughout the Pacific.

Gulf of Mexico

Electrical shrimp trawl research.—Under a Bureau contract, the Sea Technology Corp. (now a department of the Underseas Division of Westinghouse Electric Corporation), Sarasota, Fla., built to Bureau specifications an experimental electrical shrimp trawl, which was developed and tested by Bureau fishing gear experts. The Corporation later designed and is manufacturing units for use in the commercial shrimp fleet.

Shrimp research.—As a result of research at the Bureau's Biological Laboratory, Galveston, Tex., biological knowledge of the three commercially important species of shrimp in the Gulf of Mexico has increased markedly. The development of marking techniques with biological stains has enabled scientists to study the movements of shrimp from offshore spawning grounds to inshore nursery areas and return. With information on the abundance of shrimp in the estuaries and data on the fishery, Laboratory scientists have been able to tentatively forecast the abundance of commercial-size shrimp 6 months or more in the future. In addition, the scientists are making studies in the Laboratory to determine whether artificial culture is feasible for increasing the shrimp supply. Laboratory studies of the early life history of the shrimp helped the scientists identify various species of shrimp larvae and facilitated field studies of the distribution and abundance of shrimp. A broad study of spawning patterns was also completed.

Atlantic Coast

Electrotrawling trials for bottomfish.—The experimental trials of electrotrawling gear and equipment for catching bottomfish off the New England Coast began in 1962 and continued in 1963 and 1964. These trials are part of an industry–Government cooperative effort to improve commercial trawl fishing by applying principles of electric fishing. The Smith Research and Development Company, Lewes, Del., supplied the electrical equipment, which was installed on the Bureau's research vessel *Delaware*, operated from the Bureau's Exploratory Fishing Base, Gloucester, Mass.

The purpose of the electrofishing trials in 1964 was to observe, via closed circuit television, the response of fish in the path of a trawl, both with and without an electrical field. If the electrical field were kept on, the fish acted as if they were paralyzed and deep stunning followed. While in this stunned position, the fish nearly always assumed a floating position above and nearly perpendicular to the bottom. The trawl then easily overtook them. When the electrical field was not on, the fish swam in front of the net, or in and out again, depending upon towing speed. Their studies of television monitor films will enable the Base's fishing gear experts to modify the electrical trawl and again test it at sea.

Herring and groundfish serology.—Using the results of pioneering studies in serology, or blood group analysis, scientists at the Bureau's Biological Laboratory, Boothbay Harbor, Maine, identified subpopulations of herring in the western North Atlantic and scientists at the Bureau's Biological Laboratory, Woods Hole, Mass., identified sub-

populations of groundfishes in the same area. Knowledge of the occurrence of subpopulations and the degree of their overlap or mixing is essential for intelligent management and full use of these resources.

Oceanic research.—As a result of continuing research in the North Atlantic Ocean, scientists at the Bureau's Biological Laboratory, Woods Hole, Mass., forecast the abundance of groundfishes and sea scallops in New England waters. Such forecasts are extremely valuable to the fishing industry.

Surf clam survey.—Industry concern over the steady decline of surf clams in the Middle Atlantic area in recent years resulted in a preliminary cooperative Bureau–Industry exploratory survey in 1963. In July 1964 they began an accelerated exploratory fishing and gear development program to determine the number of surf clams, on a seasonal basis, between Virginia and Maine. The vessel *Rorqual* made 231 5–minute drags between Ocean City, Md., and Netomkin Inlet, Va. All drags were made along predetermined 1–mile grid lines, with a jet dredge of commercial size. Surf clams were taken in all but two of the surveyed stations. The best catches (up to 10 bushels per 5–minute drag) were made in water depths of 80 to 102 feet. Three localities off Chincoteague, Va., appear to have a commercial potential.

The program will continue in the area off Maryland and Virginia until the assessment coverage is complete. Explorations will then center off New Jersey and New York Coasts.

Tuna and swordfish explorations.—The Bureau, Woods Hole Oceanographic Institution, and other agencies continued their cooperative program of exploratory fishing for tunas and swordfish in the Northwest Atlantic. The Bureau's exploratory fishing vessel *Delaware* made a longline fishing cruise for swordfish and tuna in the spring of 1964. Catches of yellowfin tuna off the middle Atlantic Coast indicate that commercial scale stocks of this fish may exist along the edge of the Gulf Stream during spring. Yellowfin catch rates ranged up to 19 fish per 100 hooks; the average size of the fish was 74.5 pounds. Night sets of longline gear took swordfish both north and south of the Gulf Stream. The swordfish averaged over 122 pounds. These catches indicate that profitable stocks of swordfish extend over a greater area than previously fished commercially. This catch information was relayed from the *Delaware* to commercial swordfish operators fishing in adjacent waters. Smaller catches of bluefin, albacore, and bigeye tuna, skipjack, marlin, and sharks also were made during the cruise. In cooperation with personnel of other agencies, Bureau personnel tagged and released 110 tuna, 4 marlin, and 62 sharks to assist in migration studies. Bureau personnel and visiting cooperators collected various biological data.

Great Lakes

Exploratory trawling in Lake Superior.—The Bureau's exploratory fishing vessel *Kaho* located extensive concentrations of chubs in southern Lake Superior during a cruise conducted in cooperation with the local Area Redevelopment Administration program. This was the third in a series of cruises designed to assist local commercial fishermen to harvest underutilized fish stocks on Lake Superior.

Depth sounder recordings taken by the *Kaho* indicated an almost continuous body of fish at 270 to 300 feet from Munising, Mich., to Bete Grise Bay, Mich., near the end of Keweenaw Peninsula, and also in Whitefish Bay at the eastern end of the Lake. Good catches were made wherever the bottom was suitable for dragging an otter trawl at the required depth. At several locations, ½-hour drags took up to 770 pounds of chubs. Other species taken in small quantities during the cruise included smelt, herring, whitefish, and sturgeon.

The size and quality of the fish caught during this cruise and previous cruises suggest that a large trawl fishery may be feasible along the southern shore of the Lake. The largest catch made during this survey was 1,210 pounds of chubs taken in late summer near Bete Grise Bay. In this area a commercial size catch is over 200 pounds per drag.

Sea lamprey–control and lake trout–rehabilitation programs.—The sea lamprey control program, under the direction of the Great Lakes Fishery Commission, is being carried out by Governmental research teams of two countries—the U.S. Bureau of Commercial Fisheries and the Fisheries Research Board of Canada. Through continued use of chemical toxicants, lethal to lamprey larvae but harmless to game fish, the population of sea lampreys in Lake Superior has been stabilized temporarily at a level about 80 percent below that prior to control. The depressed sea lamprey population has resulted in lesser predation on trout. Biologists, who used commercial gear to sample the abundance of lake trout, found the highest catch per unit of effort for spawning lake trout since they began to keep records in 1951. They also reported fewer trout with scars made by lampreys than in any year since intensive control began.

To speed recovery of the lake trout population, cooperating agencies planted 2.6 million yearling lake trout in Lake Superior. This was the largest planting since the first one in 1958. These hatchery fish are surviving well in the Lake and compose the bulk of the trout population.

Treatments of lamprey–infested streams tributary to Lake Michigan progressed well during 1964. Over three–fourths of the known infested

streams have been treated. The remaining streams will be treated probably before the end of 1966.

Smoked fish research program.—The Bureau research program in the Great Lakes area to develop safe and practical processing methods for processing smoked fish is continuing. A federally financed, Bureau-monitored State program is in progress in Illinois, Wisconsin, Michigan, and Minnesota to assist the processors in improving their methods. A joint U.S. Public Health Service and Bureau of Commercial Fisheries Sanitation Guideline for Smoked Fish Establishments is being prepared as part of a final review procedure. The research on the smoked fish process is nearing completion, and industry has used much of the information to improve processing methods. The complete application of the guidelines and research data should preclude outbreaks of bacterial contamination in the smoked fish industry.

General

Canned pink salmon and shrimp market promotion.—At the request of CSI (Canned Salmon Institute) and GSCA (Gulf Shrimp Canners Association) and with their cooperation, the Bureau sponsored special marketing programs to sell heavy inventories of canned pink salmon and shrimp.

CSI reduced prices of the salmon; purchased and distributed copies of the Bureau's full-color recipe booklet, "Take a Can of Salmon"; designed a "Public Service Label" so that pink salmon could be used on television and in other demonstration work without showing a particular brand name; and supplied Bureau personnel with canned salmon to be used in the promotion.

GSCA, the other participant in the industry–Government marketing programs, reduced prices; directed national brokers to take specific merchandising action; provided money for printing under Bureau supervision a full-color recipe booklet, " 'Can-venient' Ways with Shrimp," and for making color transparencies and black and white food photographs for newspaper food editors; and supplied each newspaper food editor in the Nation with up to one case of canned shrimp for testing and sampling purposes.

In both marketing programs the Bureau produced and distributed food photographs in color and black and white, recipe releases, radio scripts, television scripts, and public service slides and drop cards, video-tapes, radio tapes, and school lunch, restaurant, and institutional food service recipe cards. The Bureau's marketing staff and home economists included these materials in their contacts with public media. Liaison was maintained in the salmon program with the Agricultural

Marketing Service and the Agricultural Extension Services of USDA (U.S. Department of Agriculture). USDA listed pink salmon in June and July 1964 in its "List of Foods in Plentiful Supply." Bureau releases and photographs of canned pink salmon were used in 118 newspapers with a circulation of 16 million; they devoted 42,000 lines of copy to canned pink salmon. Newspapers using the recipes and photographs of canned shrimp had a circulation of 18 million; 17 newspapers used color food photographs.

These marketing promotional programs were successful. Pink salmon sales during July, August, and September, the promotional period, were about 325,000 cases greater than for the same period in 1963. The improved movement of pink salmon continued through 1964 and was expected to carry through Lent of 1965. The canned shrimp industry also moved its entire surplus inventory. To show its appreciation for Bureau assistance, GSCA presented a plaque to the Director of the Bureau.

Cooperatives.—The Bureau provides advice and assistance to many cooperatives. Groups of fishermen in certain areas, such as Alaska, Florida, Louisiana, and Michigan, were helped to organize fishery cooperatives. Operations of cooperatives in Rhode Island, New Jersey, Florida, Texas, and Louisiana were reviewed to ensure that they complied with the Fishery Cooperative Marketing Act, and cooperatives in Massachusetts, Rhode Island, and New Jersey were given technical assistance in management problems. Some 100 fishery cooperatives with a combined membership of over 10,000 operating in 18 States produced over one-fourth of the 1964 U.S. catch of fish and shellfish on a value-of-product basis.

In response to the needs of the small-scale fishermen of the countries in the Indo-Pacific Fisheries Council, the Bureau prepared a paper on how to handle and market fresh fish.

Exploratory fishing in fresh water.—Several types of fishing gear new to local commercial fishermen were successfully tested in rice-farm fishponds near Dumas, Ark. A 2,000-foot nylon haul seine harvested nearly 2.5 tons of buffalofish and an undetermined number of small crappie in one haul in a 39-acre pond. This is the first time a haul seine of this type has been successfully used in a farm fishpond of this size. The catch was estimated to exceed 50 percent of the total number of buffalofish reported to be in the pond. Self-contained fish-transfer equipment, which moves catches from the net to a waiting truck, also proved successful when the net was emptied of the 2.5-ton total catch in about one hour.

Fish-cookery demonstrations.—As a part of the continuing program to promote the use of seafoods, Bureau home economists developed

and tested recipes for home and institutional use. These recipes are distributed as booklets and folders and made available to food specialists in magazines, newspapers, radio, and television. The home economists made 226 fish-cookery demonstrations for supervisors of school-lunch and institutional feeding programs, Agricultural Extension Service home economists, and television audiences. They also were guests on nine radio programs and participated in 17 presentations to feeding industry groups.

Fish Protein Concentrate (FPC).—The FPC research program accelerated and made significant progress in 1964. Model units for processing FPC by solvent extraction and by biological digestion procedures were constructed and installed at the Bureau's Technological Laboratory, College Park, Md. Each unit is capable of producing 100 pounds of finished product per day. Products produced in these units will lend themselves readily to incorporation into food materials for human feeding and acceptability testing on a reasonably large scale. Data from the model units will be valuable for the design and construction of the large-size commercial plants that industry anticipates.

All FPC produced in the Laboratory and in the model units is being analyzed for protein, lipids, moisture and ash, available lysine, and other tests that determine the nutritive value of the product.

A large portion of the FPC research program is being carried out by contract with private and academic research organizations. These contracts complement and extend the processing studies at the Bureau's Laboratory in College Park and include research on the chemistry of flavor reversion in FPC, lipid composition and changes in FPC during storage, protein quality and lipid stability of dried fish-tempeh mixture (tempeh is an Indonesian soybean product made with the help of a mold), survey of solvents, toxicological studies, and wholesomeness of FPC.

The development of a satisfactory FPC affords an opportunity to develop markets for the great supply of fish that remains unharvested off our coasts. These unused resources can yield about 5 billion pounds of fish per year, which would double the present U.S. catch. Harvesting these resources could provide additional employment for our fishermen and help decrease the protein malnutrition that adversely affects about two-thirds of the world's people.

Fishery educational motion pictures.—Twenty-one Bureau-produced fishery educational motion pictures are distributed nationally through 200 cooperating film libraries. Most of these films were financed by industry. About 3 million persons annually see borrowed prints of these motion pictures, and many times more see them on television. The Bureau supervised production of the motion picture, "The Sea River,"

for the U.S. Geological Survey. Since 1946, the Department of the Interior has received 22 international and national film festival awards for Bureau-produced films.

The Maine Sardine Council and the Bureau signed agreements and contracts for the Bureau to produce a motion picture, titled "Flavor of Maine."

Fishery statistics.—For each of the 43 States supporting commercial fisheries, annual data were assembled on numbers of fishermen, fishing craft, and gear used in the capture of fish and shellfish; on the volume and value of the catch; and on the production of manufactured fishery commodities. Monthly fish and shellfish landing bulletins for 19 States were issued in cooperation with the State fishery departments. Information was released each month on freezings and cold storage holdings of fish and shellfish and on the production of fish meal, oil, and solubles; and, each quarter, on the monthly production of fish sticks and portions and breaded shrimp.

International oceanographic expeditions.—The Bureau participated in two international oceanographic expeditions: IIOE (International Indian Ocean Expedition) and ICITA (International Cooperative Investigations of the Tropical Atlantic).

IIOE was conceived at the first meeting of SCOR (Scientific Committee in Oceanic Research) of ICSU (International Council of Scientific Unions) in September 1958. The plan developed at this meeting was to apply to a single ocean the type of international scientific cooperation that worked so successfully during IGY (International Geophysical Year). The Indian Ocean was selected as the site of investigation because very little was known about its properties, about the life in its waters, about its basin, and about the atmosphere above this body of water. Furthermore, some of the information gained, such as the discovery of unused marine resources, might benefit immediately the protein-deficient countries bordering the Indian Ocean.

Twenty-seven countries are participating in IIOE. Of these, 13 (Australia, France, Federal Republic of Germany, India, Indonesia, Japan, Pakistan, Portugal, Thailand, Republic of South Africa, United Kingdom, United States, and U.S.S.R.) furnished 41 ships. The other 14 countries (Burma, Canada, Ceylon, Nationalist China, Denmark, Ethiopia, Israel, Italy, Malagasy Republic, Federation of Malaysia, Mauritius, Sudan, Tanganyika-Zanzibar, and the United Arab Republic) are participating in the program with personnel only.

The Bureau participated in the biological program of IIOE by planning and carrying out the fishery aspects of five cruises in 1963 and 1964 of the R/V *Anton Bruun*, which is the research vessel of the United States Program in Biology. The basic studies undertaken were

an evaluation of the bottomfish and shellfish resources of the Bay of Bengal and the Arabian Sea and an ecological study of these resources in the central and western Indian Ocean.

The bottom trawl surveys of the Bay of Bengal and the Arabian Sea did not uncover any new fishery resources. The best catches were made off the south coast of Arabia where two hauls caught 11,200 and 4,700 pounds of fish and crabs per hour of trawling. The bulk of the catches, unfortunately, was composed of such animals as rays and portunid crabs, which are not now marketed.

The ecological study of the pelagic fishes is continuing. Preliminary results suggest that some species of fish are closely associated with certain water masses.

The full value of this expedition cannot be assessed now, because processing and publishing the data will require several years. The expedition, however, will have accomplished a great deal toward pushing back the frontiers of oceanography in a region that has been poorly explored.

The work of ICITA, the other oceanographic program, began in 1962. It is the outgrowth of The Tropical Atlantic Oceanography Fishery Program, proposed by the Director of the Bureau of Commercial Fisheries in March 1961 to ICO (Interagency Committee on Oceanography) of the Federal Council for Science and Technology. ICO endorsed the program. The Bureau made a formal recommendation for the survey April 11, 1962, to IOC (International Oceanographic Commission) of UNESCO (United Nations Educational, Scientific, and Cultural Organization). The program was endorsed by IOC, and a working group meeting, sponsored by IOC, was held in Washington, D.C., at NODC (National Oceanographic Data Center) June 20 to 23, 1962, to plan the research program of ICITA. Participating in the Working Group meeting were representatives from 14 foreign countries, international organizations, and a number of universities. Recommendations of this working group concerned biological, physical, chemical, and meteorological studies and exchange and publication of data and preparation and publication of an atlas.

The first cruise (EQUALANT I) was made with 14 vessels of seven nations (Argentina, Brazil, Republic of Congo (Brazzaville), Nigeria, Republic of Ivory Coast, United States, and U.S.S.R.) during February and March 1963 and the second one (EQUALANT II) was made with 11 vessels from eight nations (Argentina, Brazil, Republic of Congo (Brazzaville), Nigeria, Republic of Ivory Coast, Spain, United States, and U.S.S.R.) in August and September 1963. Both cruises were off the West Coast of Africa. One of the outstanding accomplishments of EQUALANT II was the first use of a satellite, *Syncom II*, for re-

laying data from a vessel at sea to NODC in Washington, D.C. While she was off the coast of West Africa, the Bureau's research vessel *Geronimo*, sent data, via *Syncom II*, to NODC, which verified the data and sent a message to the vessel within a half hour. Both cruises provided fishery and environmental data that are important for comparison with the results of similar observations in the eastern Pacific Ocean. Of immediate use to the fishing industry are observations of significant seasonal and year-to-year changes in the distribution of skipjack and yellowfin tuna in the tropical Atlantic Ocean. Data Report for EQUALANT I, compiled and prepared by NODC and printed by the U.S. Coast and Geodetic Survey, was distributed in June 1964. Data Report for EQUALANT II was sent to the printer in the late fall of 1964.

The third cruise (EQUALANT III) was in February and March 1964. Eight vessels of six countries (Republic of Congo (Brazzaville), Ghana, Republic of Ivory Coast, Spain, United States, and U.S.S.R.) cooperated in a program of direct current measurements and oceanographic and marine biological observations in the Gulf of Guinea.

In June 1964 members of ICG (International Coordination Group) for ICITA proposed to IOC that ICITA atlases be prepared. The proposal was adopted, and an ad hoc editorial committee appointed.

Irradiation of fishery products.—The food preservation industry is approaching a new era in which energy from radioisotopes will be used to destroy the bacteria that cause food spoilage. Research by the Bureau under contract with AEC (Atomic Energy Commission) has shown that many fishery products can be preserved by irradiation. The edible shelf life of haddock, ocean perch, clams, shrimp, king crab, and flounder, for example, is tripled when irradiated at levels from 100,000 to 450,000 rads (measurable absorbed energy) and stored at 33° F.

A major step toward using atomic energy to preserve seafoods on a commercial scale was taken September 28, 1964, when the MPDI (Marine Products Development Irradiator) under construction by AEC, was completed and dedicated at Gloucester, Mass. MPDI, to be operated by Bureau scientists, can process up to 1 ton of fish per hour at a dose level of 250,000 rads. This capacity will enable the Bureau to process the large quantities of fish needed for large-scale consumer acceptability experiments and will demonstrate the commercial feasibility of radiation pasteurization as a practical method of fish preservation. Since dedication, the MPDI has gone through a testing period, has performed successfully, and is expected to begin comprehensive production and experimentation in 1965.

Market News Service reporting.—In 1964 the Fishery Market News Service completed its 27th year of providing the U.S. fishing industry

with current information on supplies, demand, distribution, market conditions, and prices. Market News reporters collect, analyze, and publish this information to aid the orderly marketing of fishery products. Through its daily reports the Fishery Market News Service helps businessmen determine the markets where fishery products are needed and places fishermen, dealers, processors, brokers, and retailers on an equal bargaining basis. These reports are prepared and issued from Boston, New York City, Hampton, Va. (includes data from Baltimore, Md.), New Orleans, San Pedro, Seattle, and Chicago.

At the request of OECD (Organization for Economic Cooperation and Development), a Bureau official attended a meeting of experts in Paris in December 1964 to present his report on a fishery market news reporting service for Europe. Recommendations were developed for approval of the OECD Fisheries Committee meeting to be held early in 1965. If they are approved, a start will have been made for a fishery market news system in Europe.

Market promotional programs.—The Bureau cooperated also with the fishing industry in nine additional industrywide national promotional efforts. The Bureau's National Marketing Services Office prepared and distributed to the regional marketing staffs special food photographs, press releases, recipe releases, recipe cards, and marketing bulletins. The staffs placed these materials with appropriate public media and cooperating agencies. The promotional programs in which the Bureau assisted industry in 1964 are "August is Sandwich Month," "Bright Light Seafood Ways for Happy Holly Holidays," "Fish 'n Seafood Parade," "It's Fish 'n Seafood Time," "Maine Seafood Festival," "New England Seafoods Festival," "Outdoor Fish Cookery," "Scallop Festival Days," and "World's Fair Seafood Fare." At the Bureau's request, the U.S. Department of Agriculture listed "Fish 'n Seafood Parade," "It's Fish 'n Seafood Time," and "Scallop Festival Days" in its "Merchandising Opportunities," which is a special listing second in priority to its "List of Foods in Plentiful Supply."

The Bureau also extended marketing assistance to two State agencies and a private group. The Florida State Board of Conservation contracted with the Bureau to provide consumer information and promotional services for Florida fishery products. The Bureau produced a full-color recipe booklet, "Florida Fish Recipes," for free distribution by both cooperators; prepared radio and television programs and videotapes; released food information to newspapers, and gave 12 fish cookery demonstrations to Florida Agricultural Extension Home Demonstration Agents. This contract is the Bureau's first cooperative marketing effort with a State fisheries agency.

The Bureau and the North Carolina Agricultural Extension Service, the other State agency with which the Bureau cooperated in 1964, began a fishery products training program for the 250 home economics demonstration agents of the North Carolina agency. The agents teach homemakers on important domestic subjects, such as care and preparation of food for families.

The Bureau also helped over 100 brokers, distributors, food chain merchandisers, and others in forming the "Frozen Food Council of Georgia." A cooperative program during National Fish and Seafood Month resulted in a 25-percent increase in the sale of fishery products in Georgia in October 1964.

Pesticides research.—Studies of the effects of pesticides upon commercial fish and shellfish increased. Over 135 separate pesticide chemicals were screened in laboratory tests for acute and chronic toxicity and accumulation and persistence of residues in several representative groups including oysters, shrimp, plankton, and fish. Field studies were begun in Santa Rosa Sound, Fla., to measure seasonal and spatial variations in pesticide residues in oysters and fish. Contracts were developed with several laboratories throughout the country to monitor pesticides in the natural environment. Basic studies to determine the effect of pesticides upon physiological processes also were undertaken.

Reservoir research.—A biological research program was begun on Oahe Reservoir, S. Dak., during the fall of 1963, to study commercial fish populations and to develop recommendations for achieving the best use of the commercial fishery resource.

During 1964, over 95,000 fish in Oahe Reservoir were fin-clipped or tagged to trace their movements and to determine the sizes of their populations.

Buffalofish, carp, drum, carpsuckers, and goldeye are the dominant commercial species in the Reservoir. Good reproduction of fish occurred in 1959 and 1962, and the present fish population is comprised largely of fish hatched in those years. The few recoveries of marked fish indicate that buffalofish make a seasonal migration.

Scientist training.—To alleviate the growing shortage of qualified, well-trained scientists in oceanography, an educational grant program, providing funds to universities for graduate training of students in the aquatic sciences, was begun in 1962. In the academic year 1964–65, 49 graduate students are being supported in 25 universities in the United States. Scientists trained in this program will benefit the Bureau and the total National Oceanographic Program.

Transportation.—The transportation program consists of research and service. A paper was prepared describing the importance to the fishing industry of the fishery exemption from economic regulation by

the Interstate Commerce Commission. An analysis of routes and transportation service was prepared for the overall economic research study designed to determine the economic feasibility of developing certain fishery resources of Lake Superior. Appearances were made in two regulatory proceedings and testimony was prepared for one. Statistics and information were furnished to aid in several negotiations between carriers and the fishing industry to improve transportation and services for fishery products.

U.S. grade standards for fishery products and inspection service.—During 1964, the Bureau helped establish standards of identity for raw breaded shrimp and lightly breaded shrimp. These standards, administered by the Food and Drug Administration, impose mandatory requirements for the amount of shrimp meat in these products. The Bureau proposed that existing grade standards for raw breaded shrimp be revised to incorporate changes that will help upgrade the quality and keep pace with production capabilities of the fishing industry.

There was increased acceptance of fishery inspection services during 1964. Twenty-four State Governments, three Federal agencies, and several large municipalities are using available fishery inspection services. During 1964 about 220 million pounds of fishery products were inspected. Of this total, 211 million pounds were fresh and frozen products produced in about 40 firms subscribing to the voluntary continuous inspection program. In addition, 9 million pounds of canned products were lot inspected for quality and condition. In response to increased demands for inspection service, a new lot inspection office was established in New Orleans, La.

Water resource developments.—A River Basins supervisor and staff are included among Bureau of Commercial Fisheries personnel in the Alaska region of the Bureau, with headquarters at Juneau. This group assesses the effects of various proposed water development projects on the fish and wildlife resources and recommends measures and facilities that will mitigate losses or, if possible, enhance fish and wildlife values. An outstanding example of this planning activity is reflected by the measures proposed in the Fish and Wildlife Service's report on the proposed Rampart Dam on the Yukon River, Alaska.

During 1964 the Washington office and each regional office (except Region 6) established a River Basin Studies Coordinator position. These positions will assure that broader and more complete coverage of commercial fishery aspects will be given in the Fish and Wildlife Service reports that assess the effects of proposed water development projects on the fish and wildlife resources involved. Examples of planning activities in 1964 for various water development projects include the proposed Passamaquoddy and Texas Basin projects, the Peripheral Canal

Plan for the Sacramento–San Joaquin Delta in California, the Lake Michigan Basin segment of the Great Lakes–Illinois River Basin project, the proposed Chesapeake–Delaware Canal project, and the Salem-Church project on the Rappahannock River, Va.

Some attention was also given to various oil and gas problems associated with offshore seismic explorations and drilling operations.

Fisheries Financial Assistance Programs

In fiscal year 1964 the Bureau continued its loan programs to aid the fishing industry. A report of the activities under each program follows.

Fisheries Loan Program

The Fisheries Loan Program continued operations which began in the latter part of 1956. During the 1964 fiscal year, 219 applications, requesting $5,240,655, were received, bringing the total since the program began to 1,487 for $39,840,256 (app. C). During the year the Bureau approved 118 applications for $2,329,812 and declined 47 applications for $723,030. Victims of the Alaskan earthquake of March 27, 1964, received about one–third of the funds loaned during fiscal year 1964. The earthquake, followed by seismic sea waves, destroyed or damaged fishing vessels and gear from Alaska to California. The heaviest damage was suffered at Kodiak, Alaska. Money from the Fisheries Loan Program enabled many of the victims to replace or repair fishing vessels and gear in time for the summer fishing season.

Fishing Vessel Construction Differential Subsidy Program

June 12, 1963, was the last date for accepting applications under the Fishing Vessel Construction Differential Subsidy Program which began in 1960 as authorized by Public Law 86–516. On August 30, 1964, Public Law 88–498, amending P.L. 88–516, was approved. This new legislation modified the conditions under which the Secretary of the Interior is authorized to pay a subsidy for constructing U.S. fishing vessels; authorized the appropriation of not more than $10 million annually to carry out the purposes of the Act; and extended the term of the Program until June 30, 1969. To carry out the purposes of the Act during fiscal year 1965, $2.5 million were appropriated.

Fishing Vessel Mortgage and Loan Insurance Program

The Fishing Vessel Mortgage and Loan Insurance Program, which provides for the Government insurance of mortgages given for the con-

struction, reconstruction, or reconditioning of fishing vessels was continued. During the year, 24 applications for insurance on mortgages totaling $998,874 were received, bringing the total to 55 for $4,896,614. Twenty–five applications involving $1,050,620 were approved during the year, and 2 for $995,000 were pending as of June 30, 1964. Since this Program began in 1960, approvals totaled 48 for $3,239,095. Interest in this Program by vessel owners and lending agencies continued to grow throughout the year.

New Programs

In 1964 the Bureau began several new research programs in biology, economics, and technology to aid the fishing industry.

Economics Program

The program of economic research includes studies in the areas of resource use, supply, demand, and marketing.

Two projects were started in the area of demand and market research. The first project is an investigation of how prices, economic growth and income, and availability of competing goods affect consumption of fishery products, and also a study of the interrelation between demands for different fishery products. Increased knowledge of the factors underlying the demand for fish and fishery products will aid industry to market fish and fishery products in such a manner that the greatest potential value will be realized. The second project is a study of cost and efficiency in handling, transporting, and processing fresh and frozen fish products. It is designed to study, in particular, the feasibility of using various types of containers for these products.

Several projects were begun also in the area of supply and resource use. One project is a study of the Great Lakes fisheries. The first phase of this project is to evaluate the possibilities for increasing the return from the Lake Superior cisco fishery. The second phase is to analyze other methods of managing the Lake Superior trout fishery so that the best economic yield can be obtained. A second project is an analysis of economic returns to the capital and labor in the New England trawling industry. Preliminary results of this study show that not only are hourly wages in the New England trawl fishery low compared to wages in other occupations in New England but that return to capital is also quite low, with some vessels unable to adequately cover depreciation.

Foreign Trade Promotion

The Bureau continued to explore possibilities for developing foreign markets for U.S.–produced fishery products. The United States is

basically an importer of fishery products. With increased earnings in Western European countries, however, certain European countries have a potential market for many U.S.–produced species. Arrangements are to be made for domestic producers and processors to exhibit and sell their products in future international trade fairs.

Lobster Studies

The Bureau's Biological Laboratory, Boothbay Harbor, Maine, began a study of the northern lobster to determine the relation between the lobster stocks along the coast and offshore. The increased fishery for large lobsters on the edge of the Continental Shelf and the declining catches of smaller lobsters in the inshore areas have raised questions of the interrelationship of these two stocks.

Pesticide Review Staff

In 1964 the Pesticide Review Staff of the Department began functioning. The Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries are the only bureaus of the Department participating in this cooperative program at present. All applications for pesticide registration submitted to USDA (U.S. Department of Agriculture) for possible effects of pesticides upon fish and wildlife are reviewed by this group. The Staff recommends to USDA any changes it deems necessary to minimize the effects of the pesticides on forms.

Submarine Feasibility Study

Under a Bureau contract, the Electric Boat Division of General Dynamics Corporation, a leading builder of submarines, made a feasibility/conceptual design study for a fishery–oceanography research submarine for the Bureau's Biological Laboratory, Honolulu. The Electric Boat Division determined that a submarine capable of accomplishing the Bureau's missions should be 163 feet long and 23 feet wide, powered by a nuclear reactor, and manned by a 24–member crew and 7 scientists. The submarine would operate to depths of 1,000 feet. Its submerged speed would be 20 knots, and its submerged endurance 6 weeks. It would have a bow observation sphere for studying fish directly; remote–controlled television cameras for viewing areas not visible from the bow sphere; a complex system of instruments for measuring environmental factors and for providing data to a computer; a decompression chamber for personnel who transfer from submerged dwellings; and a stern tube through which collecting devices, such as trawls, plankton nets, bottom samplers, and trolling lines, could be

launched and recovered while the submarine was submerged. This submarine's range, speed, maneuverability, and endurance should make possible a major breakthrough in collecting chemical, physical, and biological oceanographic data.

Surf Clam Study

Because of the U.S. fishing industry's concern over the recent declining abundance of surf clams along the Middle Atlantic Coast, the Bureau in 1964 began a study of the reproduction, growth, distribution, and other aspects of biology of the surf clam. This research is being performed by personnel at the Bureau's Biological Laboratory, Oxford, Md. The aims of the study are to learn the cause of its decline and to find a means of restoring the clam to its former abundance.

Meetings

Officials of the Bureau participate in many meetings that directly concern the U.S. fishing industry and involve U.S. policy. For use at these meetings of private, national, or international organizations, Bureau officials prepare U.S. position papers, background studies, and briefing statements. Matters discussed at these meetings include conservation and wise use of fishery resources, present and future fishery research, trade problems caused by rivalry among nations for fishery markets, and establishment of territorial waters.

The important international meetings in which Bureau officials participated in 1964 are given here.

Conference on International Traffic in Animals and Animal Products

The Conference of FAO–OIE–WHO (Food and Agriculture Organization of the United Nations, Office of International Epizootics, and World Health Organization) at Berne, Switzerland, October 12 to 17, 1964, considered standardizing and harmonizing regulations on international traffic in fish and fishery products. Of particular interest to the United States was the proposal that all fish meal offered for international trade be subjected to heat sterilization to eliminate *Salmonella* bacteria, which cause intestinal disturbances in man and other animals and are occasionally found in fish meal. The bacteria are found particularly in fish meal plants that use contaminated harbor water in processing the fish. The United States held that heat sterilization of the fish meal would cause a loss of nutritive value and that better plant sanitation practices could adequately control *Salmonella*. The Conference upheld the U.S. position.

Food and Agriculture Organization of the United Nations (FAO)

Business Decisions in Fisheries Industries.—FAO held an international meeting on Business Decisions in Fisheries Industries in Rome September 21 to 25, 1964. The purpose of the meeting was to improve collaboration between executive personnel in the fisheries and professional researchers, such as biologists, economists, engineers, and technologists. Executives benefit by learning more about the tools used by researchers in their analyses and by knowing the type of assistance available from researchers. The discussions emphasized that decision making is improved by replacing rule–of–thumb and intuitive judgments with quantitative methods of analysis. FAO will issue a report containing material on all technical papers and summaries of the discussions.

Forty–third Session of the Council of the Food and Agriculture Organization.—At its 43d session in Rome October 5 to 15, 1964, the Council of FAO considered raising FAO's Fisheries Division to departmental status. The Council established an ad hoc committee to consider the upgrading of the Fisheries Division and to make recommendations to the 44th session of the Council, scheduled to meet in June 1965. With fisheries work administered through a separate department, FAO could fulfill better its position as the leading intergovernmental fisheries body in encouraging wise harvesting of food from the oceans and inland waters.

The Council considered also a proposal to establish an organization for conserving and wisely using Atlantic tunas. Most of the delegations, including the U.S., favored a new organization. The Council, however, decided to refer the matter to the 13th session of the FAO Conference, scheduled for November and December 1965. The session will consider whether a conference of plenipotentiaries of interested nations should be called to discuss the character, functions, and operations of such an organization and, if agreement is reached, to take steps to set it up.

Indo–Pacific Fisheries Council (IPFC)

The Bureau participated in the 11th session of IPFC in Kuala Lumpur, Malaysia, October 16 to 31, 1964. The Working Party on Tuna, established at this session, is to assemble data for assessing tuna stocks in the Indo–Pacific region and suggest other surveys and observations on tunas.

Inter–American Tropical Tuna Commission

At the 16th annual meeting of the Inter–American Tropical Tuna Commission at San Diego, Calif., March 18 and 19, 1964, members of

the Commission considered the quantity of yellowfin tuna to be taken from the eastern Pacific in 1964. The participants recommended a quota of not more than 77,000 tons. In the absence of effective legislation to enforce the quota, however, about 107,000 tons were taken. Research by the Commission had established the maximum sustainable yield of yellowfin stocks in the eastern Pacific to be about 91,500 tons a year. In 1960, 1961, and 1964, however, this amount was exceeded.

International Biological Program (IBP)

The first general meeting of IBP, held in Paris July 23 to 25, 1964, led to the establishment of several ad hoc working groups. Of these, Ad Hoc Working Group C was delegated to discuss and report on problems concerning productivity of marine communities. This group proposed that the marine section of IBP focus its work on fundamental ecological studies as a contribution toward the scientific basis for improving accessible resources around land masses. It agreed also that IBP should explore ways of improving communication between scientists and emphasized the need of collaborating with international organizations in marine science.

International Council for the Exploration of the Sea (ICES)

ICES held its 52d statutory meeting in Copenhagen September 28 to October 7, 1964. Among the more important conclusions reached at the meeting were the decisions to develop a research plan for the tropical Atlantic and to organize the collection of fishery statistics from that area. The extensive fishery on sardines, tunas, and other species in the area prompted this action. A symposium, expected to be convened in 1966, will draw up the details of the plan, known as the Equatorial Project.

Prior to the meeting, member countries worked out the new convention for ICES and deposited it with the Danish Government. It emphasizes the responsibility of ICES for promoting and encouraging the study of the sea, particularly its living resources. It widens the ICES area to cover the Atlantic Ocean and adjacent seas, although ICES will be primarily concerned with the North Atlantic. The ICES area was confined previously to the eastern part of the North Atlantic, primarily off Europe and Iceland.

International Whaling Commission (IWC)

IWC established a committee of scientists in 1960 to study the statistics of the catch of Antarctic whales over the past 30 years and to recommend proper measures to protect these stocks. The Commission

agreed to implement the conservation measures no later than July 31, 1964.

At the 16th annual meeting of IWC, at Sandefjord, Norway, June 22 to 26, 1964, the scientists reported that whale stocks were nearing extinction. The catch of blue whales, the largest and most valuable species, had declined from 9,192 whales in 1946–47 to 102 in 1963–64; and the catch of fin whales, from 28,764 in 1960–61 to 13,870 in 1963–64. The scientists recommended that taking blue and humpback whales be prohibited for 50 years, and that capture of fin whales be limited to no more than 4,000 whales a year until the stocks begin to increase. The Commission failed to act on the recommendations as agreed but later met informally to approve a quota far in excess of that presented in the scientists' report.

The scientists' other proposal was defeated. Japan, the Netherlands, Norway, and the U.S.S.R., who have pelagic whaling operations in the Antarctic, opposed the proposal for effective conservation action for other species of whales (principally fin, sei, sperm, and humpback). The necessary three–quarters' majority for acceptance of the proposal was not obtained, because representatives of 4 of the 14 countries present at the meeting objected to it. Arrangements also were made for the Food and Agriculture Organization to continue to cooperate with IWC in assessing the whale stocks and predicting their yields.

Since the meeting, the Netherlands withdrew from pelagic whaling operations in the Antarctic and sold its national quota and factory ship to Japan.

North Pacific Fur Seal Commission

At its seventh annual meeting, held in Moscow February 24 to 27, 1964, the North Pacific Fur Seal Commission reviewed the fur seal research and management activities on the Commander, Robben, and Pribilof Islands during 1963. The size of the herds on the Commander and Robben Islands had continued to increase. The Pribilof herd was thought to be nearing its optimum size; however, further intensive research is being made because an element of uncertainty exists regarding this belief. The United States and U.S.S.R. are making special efforts to reduce the heavy mortality of young fur seal pups that occurs in some years. The Commission also reviewed and approved the plans developed by the Parties for fur seal investigations in 1964 both on land and at sea.

Organization for Economic Cooperation and Development (OECD)

The OECD Fish Technologists' meeting was held in Scheveningen, Netherlands, September 14 to 17, 1964. The Fisheries Committee of

OECD sponsored this meeting as part of its 1964 work program. The fishery technologists, who had not had an opportunity to attend a meeting of this type since 1956, discussed five major topics: (1) storing fish in chilled sea water on fishing vessels, (2) prepackaging fresh, frozen, smoked, and other fishery products for retail sale, (3) handling wet fish aboard vessels, (4) handling wet fish on shore, and (5) freezing, cold storage, and thawing. Perhaps the most significant development of the meeting was a report by a Portuguese trawler owner that he was successfully supercooling his catch to 30–27° F. and bringing in the partially frozen fish after 25 to 30 days in a condition that commanded premium prices. The method is not supposed to be theoretically sound but apparently was applied successfully in this instance to warm-water species taken off the northwest coast of Africa.

Cooperation and Coordination with International, Federal, State, and Other Agencies

Through cooperation with various foreign governments, other Federal agencies, States, universities, and private organizations, the Bureau makes the best use of the skills and facilities of the scientific community and promotes the exchange of ideas and results. The Bureau also coordinates its programs with those of these various groups. The cooperation and coordination are effected through international agreements and treaties and formal and informal arrangements.

Cooperation with International Groups

Through cooperation, countries develop and exchange information needed for solving mutual problems. International organizations, such as Food and Agriculture Organization of the United Nations, International Commission for the Northwest Atlantic Fisheries, International North Pacific Fisheries Commission, and the Great Lakes Fishery Commission, coordinate the research efforts of a number of countries.

Cooperation with Federal Agencies

The Bureau has formal and informal agreements with other Government agencies—Atomic Energy Commission; Department of Agriculture; Department of Commerce (including Weather Bureau and Bureau of Census); Department of Health, Education and Welfare; Department of Labor; Department of State; Department of the Treasury; Federal Trade Commssion; and various defense agencies.

Advice to Area Redevelopment Administration (ARA).—The Bureau continued its activities as a delegate agency of ARA. The Area Re-

development Act of 1961 authorizes the Bureau's activities, which involved investigating fishery industry applications for Federal financial assistance under the provisions of the Act and then making recommendations to ARA. Among the proposals were several requests for technical assistance grants to study the possibilities of expanding fish and shellfish resource use in particular areas. The Bureau, for example, recommended that ARA help finance a study of the economic feasibility of a fish reduction plant to use rough fish from the Tennessee Valley Authority reservoirs. The Bureau also reviewed and reported on requests for commercial loans to establish or expand plants processing and marketing fishery products. Bureau experts monitored several projects involving commercial fishery research that could not be fitted into the Bureau's program and, therefore, came under ARA financing. The commercial fishery projects financed with ARA funds were successful in creating new jobs and increasing family income in several economically depressed areas.

Cooperative census of commercial fisheries.—The Bureau collaborated with the Bureau of the Census in making the 1963 census of commercial fisheries—the first such census since 1908. The program was designed to collect bench mark data that will be helpful in evaluating interim reports published by other agencies. The data collected, relating to employment, payroll, boat and vessel characteristics, species landed, gross receipts, and other items, will help scientists analyze the economic position of the industry. Tabulations of the census will continue into 1965.

Cooperative Columbia River mouth survey.—The cooperative study between the Bureau and the U.S. Atomic Energy Commission concerning deepwater marine resources off the coasts of Washington and Oregon was continued during 1964. Field work involved periodic sampling during three cruises with trawling and dredging gear at a series of standard stations along a trackline running offshore from the mouth of the Columbia River to a depth of 6,000 feet.

The dominant fish species caught during winter and spring cruises were similar to those taken previously. As in past years, Dover sole and Pacific hake were almost absent from catches during the winter cruise but formed a conspicuous part of the spring catches in the 300- to 600-foot depth range. Rex sole and arrowtooth flounder were two of the dominant species found out to depths of 1,200 feet during winter but were insignificant in catches beyond 600-foot depths during spring.

Catches of invertebrates remained essentially the same as those made on previous surveys at depths shallower than 2,700 feet. Sampling at depths beyond 2,700 feet took a number of species new to the trackline.

The primary aim of the third cruise, made in September 1964, was to evaluate the relative fishing capabilities of the two basic sampling gears used on the project—a 70–foot semiballoon shrimp trawl and a 94–foot fish trawl. The fish trawl was vastly superior to the shrimp trawl for taking fish. Catches of invertebrates for both trawls, however, were about proportional to the horizontal spread of the nets.

Cooperative survey of fisheries production in Brazil.—Five Bureau scientists assisted AID (Agency for International Development) by surveying fisheries production in the fresh–water reservoirs of Northeast Brazil. They found that one problem in increasing production involves the piranha, which inhabits much of the fresh–water area of the northeastern States. The piranha consumes large quantities of food fish and attacks people and livestock, often causing serious injuries or death. The Bureau advised AID to finance the purchase of the chemical used to eradicate the piranha and to furnish technical assistance that would help improve the marketing and transportation of fish for the people of northeastern Brazil.

Cooperative survey of Pacific salmon.—At its meeting June 11, 1964, in Portland, Oreg., the Pacific Salmon Inter-Agency Council studied standardization of salmon statistics, identification of salmon from various rivers, collection of escapement estimates, a uniform interchangeable system for automatic processing programming and analyzing data, and the need for a careful economic study of the salmon resource. A committee of fishery scientists from each member agency reviewed the research by all agencies along the Pacific Coast and the status of the resources in various management areas. Inventory reports have been compiled of research programs, hatcheries, spawning channels, and protecting devices, such as screens and fishways. The Council has recommended action to lessen water pollution in the Willamette River and to reduce mortality of migrating salmon at dams and turbines.

The Council, formed in 1963, includes members from three Federal agencies (Bureau of Commercial Fisheries, Bureau of Sport Fisheries and Wildlife, and Corps of Engineers) and seven State agencies (Alaska Department of Fish and Game, California Department of Fish and Game, Idaho Department of Fish and Game, Fish Commission of Oregon, Oregon State Game Commission, Washington State Department of Fisheries, and Washington State Department of Game).

Cooperation with States

The Bureau cooperates in its formal agreements with States through the Atlantic States Marine Fisheries Commission and the Gulf States Marine Fisheries Commission. Such interstate commissions coordinate the research efforts and conservation actions of the States involved in

such compacts. This coordinated action is based mainly on scientific data provided by Bureau researchers.

The Bureau and all coastal and inland States that have commercial fisheries have cooperative arrangements for collecting and compiling fishery statistics.

Cooperation with City of Milwaukee

Following Bureau specifications and recommendations, officials of Milwaukee, Wis., had an air–bubble curtain constructed and installed in the Milwaukee River to concentrate large quantities of alewives that were migrating up the River. In past years dying and decayed fish had accumulated along the shores of the River, creating unsanitary conditions and a difficult problem of removal. The curtain is expected to block the upstream run and lead the fish into an impoundment where commercial fishermen can load and haul them to a newly constructed fish meal plant in Milwaukee. The month–long tests of the curtain by Bureau and Milwaukee officials were promising.

Cooperation with National, Regional, and Local Groups

The Bureau cooperates closely with a number of national, regional, and local fishery and allied trade associations. This cooperation draws upon nearly all research, development, and service functions of the Bureau. The Bureau uses the professional talent and research facilities of universities, State agencies, trade associations, and private organizations by contracting with such groups to supplement Government research and service activities. Appendix D lists the organizations with which the Bureau had research and development contracts and grants in 1964.

Cooperative Guinea Undercurrent survey.—On the Bureau's fishing vessel *Geronimo* in August and September 1964 Bureau scientists and oceanographers from Lamont Geological Observatory, Columbia University, cooperatively made direct current measurements in the Gulf of Guinea. Subsurface drogues revealed that the Guinea Undercurrent extends along the West Coast of Africa, at least from long. 8° W. to about the Greenwich meridian and offshore (south) to about lat. 0°30′ N. Preliminary analyses of current meter data show the Undercurrent at depths in excess of 1,640 feet with the maximum flow coinciding with the core of maximum salinity (at about 164 to 229.60 feet). The mean velocity computed from drogue stations along long. 8° W. was 0.4 kn. Finding the Guinea Undercurrent confirmed the hypothesis of Bureau scientists that there is a previously unreported subsurface current in the eastern tropical Atlantic Ocean.

Organization, Employment, Budget, and Physical Properties

Organization

In 1964 there were no organizational changes in the Headquarters Office in Washington, D.C., of the Bureau. The field organization of the Bureau, however, was revised by redistributing the western States between two regions. Region 1, redesignated Pacific Northwest Region, retains the States of Washington, Oregon, Idaho, Montana, and Wyoming. The new Region 6, designated Pacific Southwest Region, takes over the States of California, Nevada, Utah, Arizona, Colorado, and New Mexico. A chart of the Bureau's organization as of December 31, 1964, is shown in figure 1, and a map of the six regional and one area offices as of December 31, 1964, and the territory under each is shown in the frontispiece.

Employment

The total employment for the Bureau averaged 2,165 throughout calendar year 1964. Of this total average, 1,822 were permanent and 343 were seasonal employees. The peak employment for 1964 was reported at the end of July, at which time the staff consisted of 1,822 permanent and 585 seasonal employees, making a total of 2,407. The variations in the number of employees throughout 1964 and the relation between the total number and the number of permanent employees and seasonal, or temporary, employees are shown in figure 2.

Bureau employees fall generally into four broad categories. Of the total of 1,976 full-time employees reported as of October 31, 1964, 884 were classified in about 43 professional and technical series; 254 in 12 subprofessional series; 463 in 34 administrative and clerical series; and 375 were in positions, the pay of which is determined outside the Classification Act (166 vessel positions, 209 other). Figure 3 shows the grade structures for the professional and technical series, subprofessional series, and the clerical and administrative series and the number of employees in each grade for these three classifications as of October 31, 1964.

Budget

For the fiscal year 1964, $35.8 million were available to carry out the Bureau's program (app E). Of this amount, $27.7 million were from annual appropriations; $5.3 million from Public Law 466 (known as the Saltonstall–Kennedy Act) funds; $0.8 million made available to

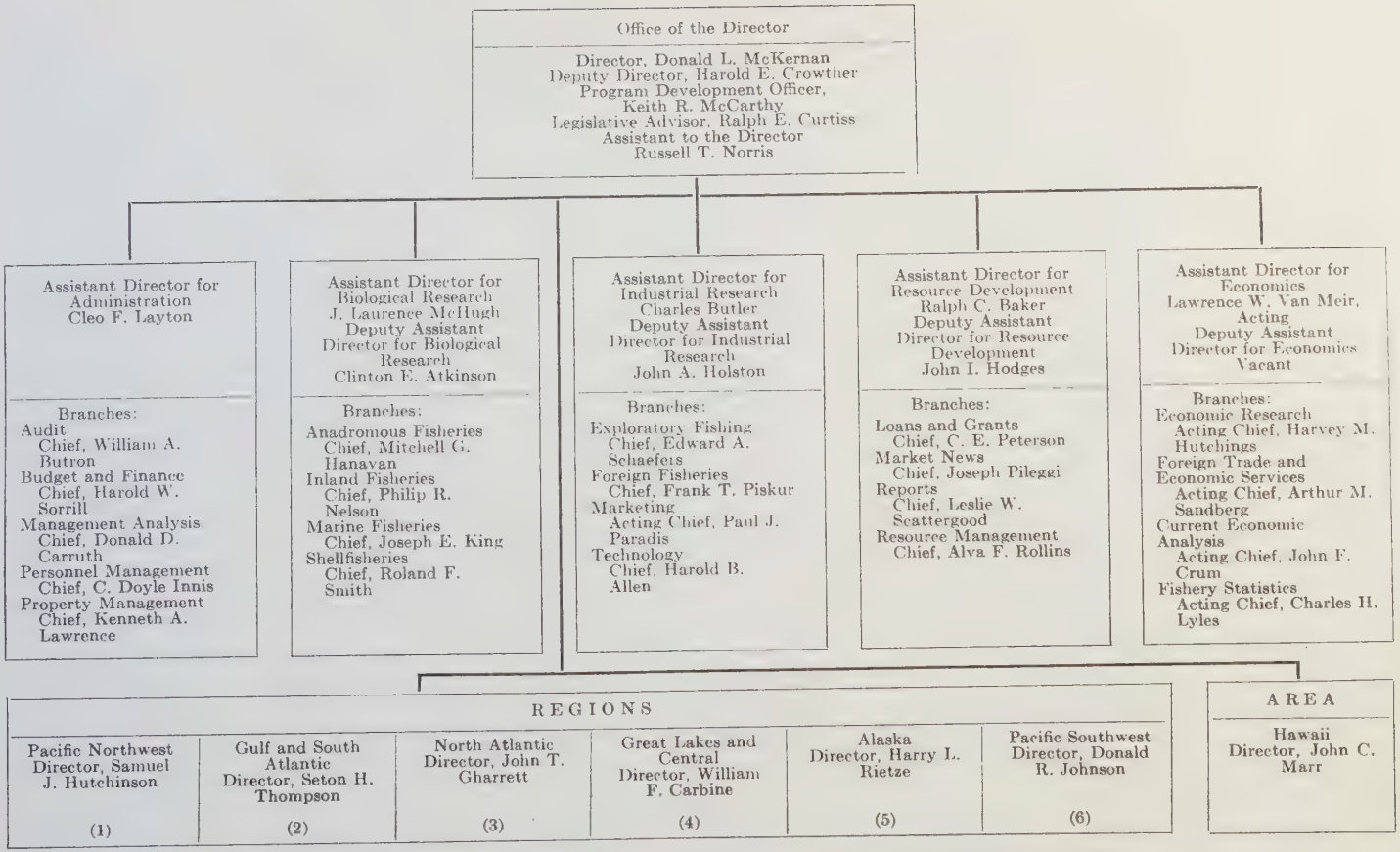

FIGURE 1.—Organization Chart, Bureau of Commercial Fisheries, December 31, 1964.

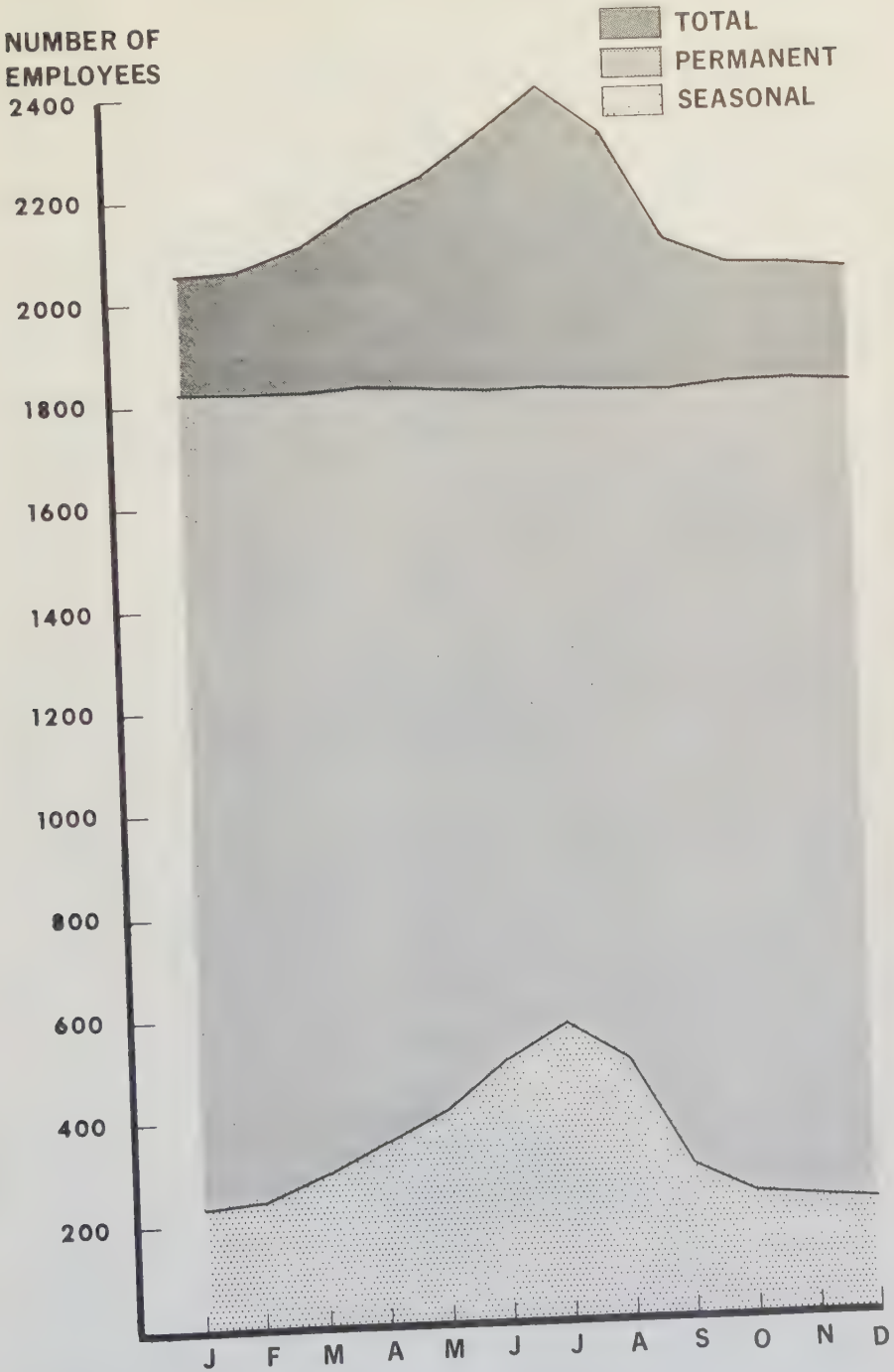

FIGURE 2.—Bureau of Commercial Fisheries employment totals by month, calendar year 1964.

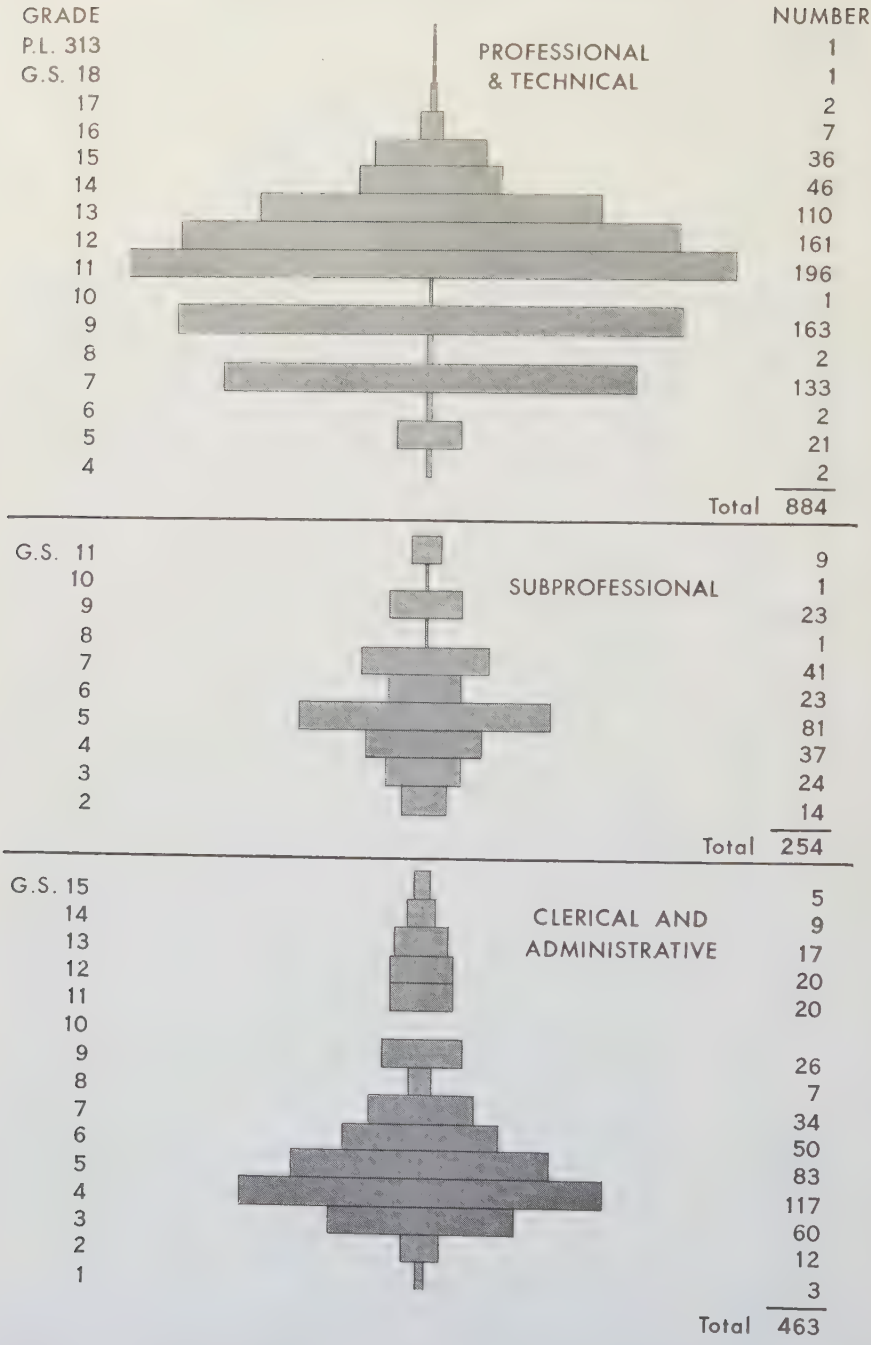

FIGURE 3.—Distribution by grade of professional and technical, subprofessional, and clerical and administrative employees, Bureau of Commercial Fisheries, October 31, 1964.

the Bureau by the Great Lakes Fishery Commission; and $0.6 million from members of the fishing industry for inspection and grading of fishery products.

Figure 4 shows the available funds to carry out the Bureau's program for each year from 1957 to 1964.

Physical Properties

Field laboratories and stations, vessels, and installations on the Pribilof Islands are the principal properties of the Bureau (app. F).

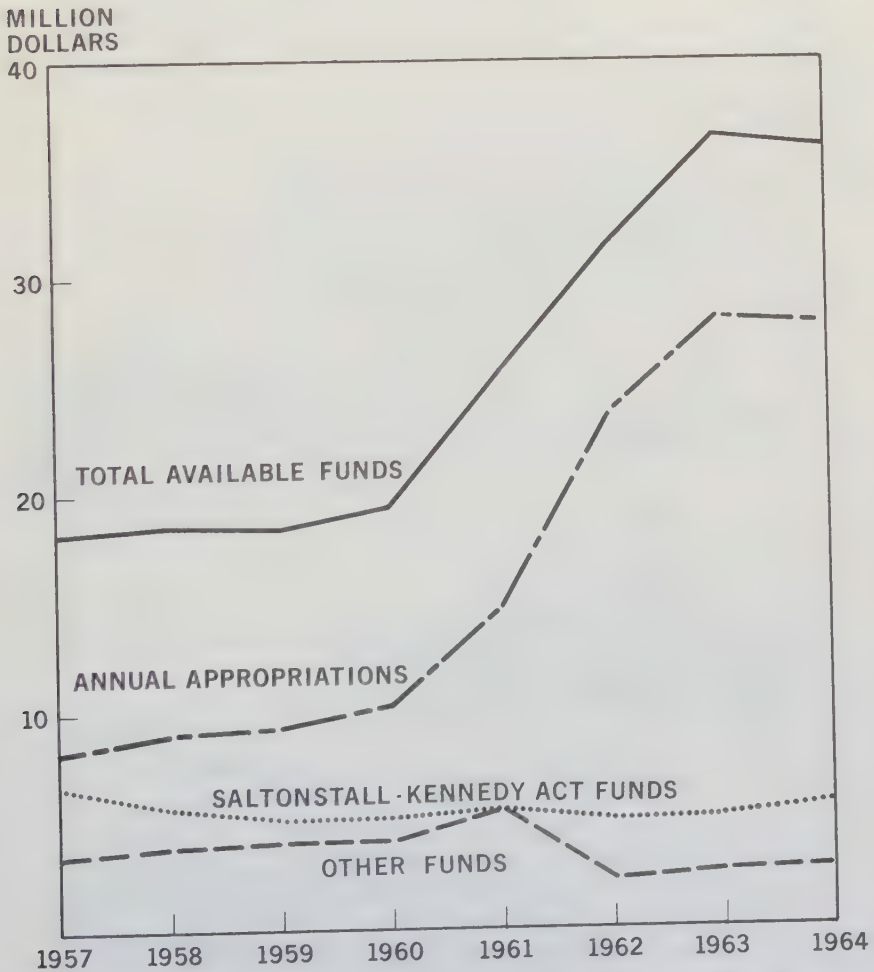

FIGURE 4.—Funds available to the Bureau of Commercial Fisheries, fiscal years 1957–64.

In fiscal year 1964, replacement and improvement of Bureau facilities continued and new projects for construction were begun or were planned. In fiscal year 1964, there were 25 large laboratories and installations, 73 smaller stations and offices, and 28 vessels of 40 feet and longer. Figures 5, 6, and 7 show the Bureau's principal fishery biological research laboratories, and figure 8 shows the principal exploratory fishing and gear research and technological laboratories.

Three laboratories were under construction in 1964, and one of these was completed and dedicated in October. The new laboratory is in La

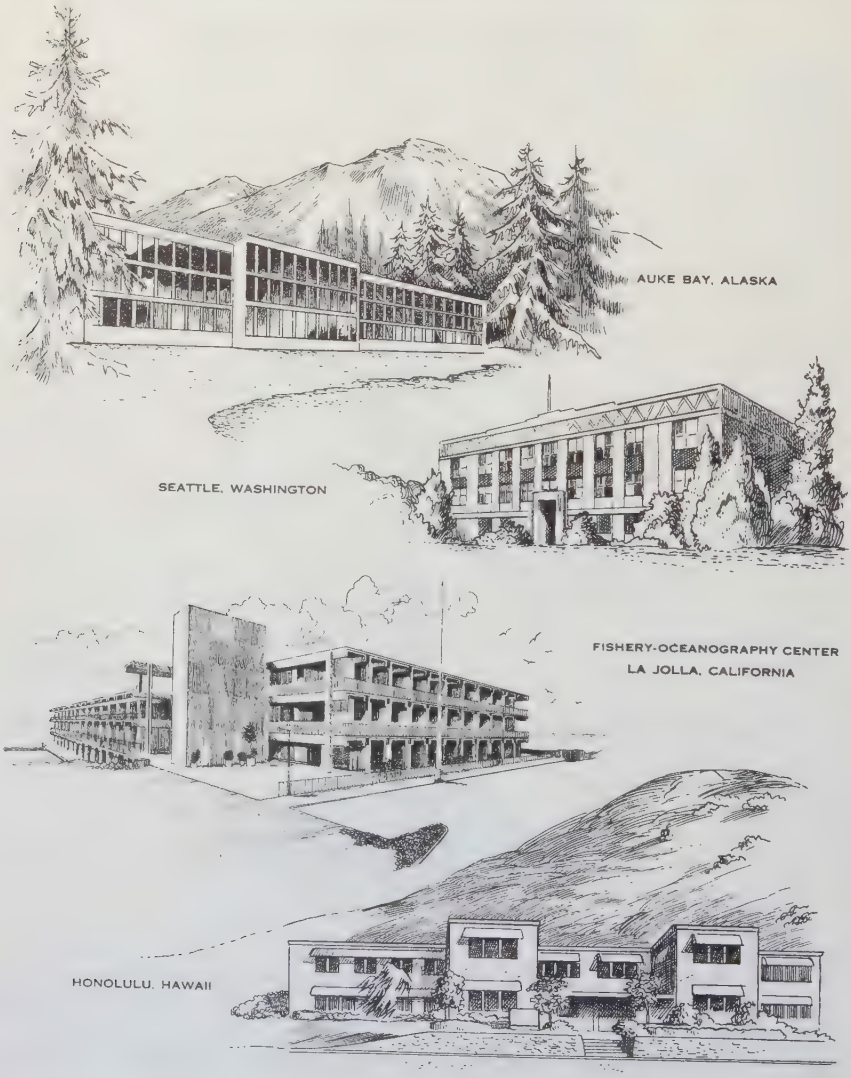

FIGURE 5.—Bureau of Commercial Fisheries biological laboratories, Pacific, 1964.

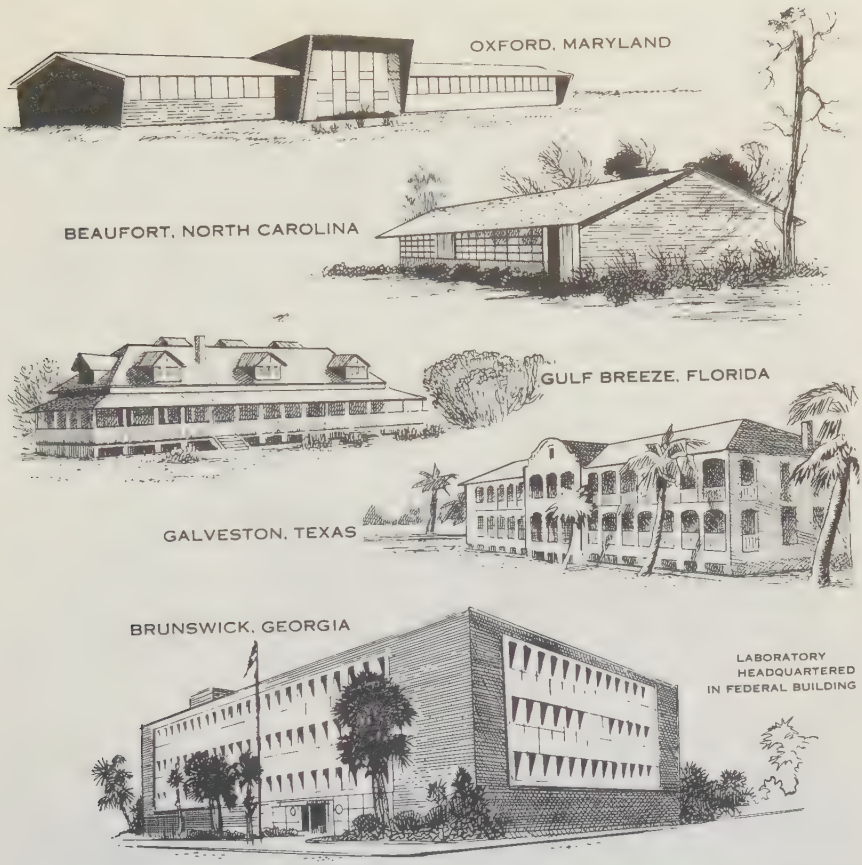

FIGURE 6.—Bureau of Commercial Fisheries biological laboratories, Middle and South Atlantic and Gulf Coast, 1964.

Jolla, Calif., within the campus area of the University of California at San Diego. It is a fishery–oceanographic center suited to carry out the provisions of the National Oceanographic Program. It cost $2.2 million and provides facilities for investigations of genetics, survival, behavior, distribution, movements, and abundances of tunas, sardines, and associated species. Construction of the second biological laboratory in Seattle, Wash., was nearing completion in late 1964. It will provide space and improved scientific facilities for oceanographic research and biological research on stocks of marine and anadromous fishes of the North Pacific Ocean and for the national program for research on fish passage problems. Construction of the third laboratory, the radio-biological research laboratory at Beaufort, N.C., was begun. It will replace a temporary wooden building used for the past 10 years. The

new building will have facilities for handling atomic materials in connection with the radiobiological program.

Three contracts for constructing research laboratories were given. One contract was for a $1,308,830 research laboratory at Ann Arbor, Mich., on the north campus of the University of Michigan. This laboratory will house the biological and technical staff for this area, who are using temporary quarters. The other contracts were for the design of a Shellfish Research Center in Milford, Conn., and a Biological Laboratory in Miami, Fla., authorized by Congress. The Shellfish Research Center is for basic research on physiology and ecology of commercial shellfish and methods for artificial culture of shellfish. The laboratory at Miami will house the research facility for Investigations of the Tropical Atlantic which is now in the Bureau's Biological Laboratory, Washington, D.C.

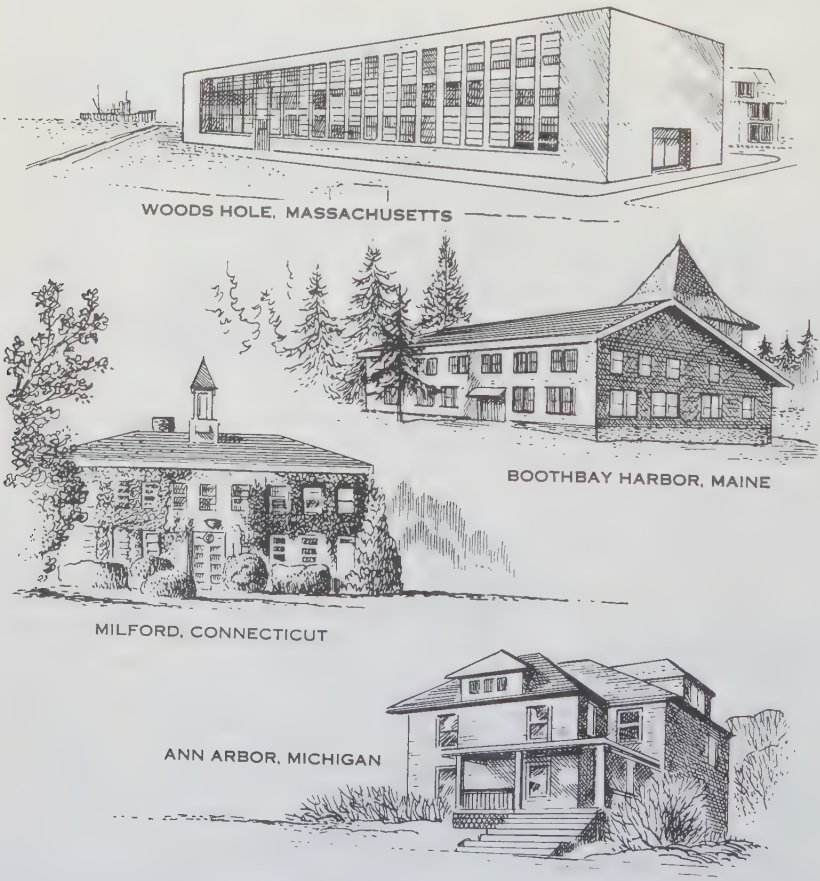

FIGURE 7.—Bureau of Commercial Fisheries biological laboratories, North Atlantic and Great Lakes, 1964.

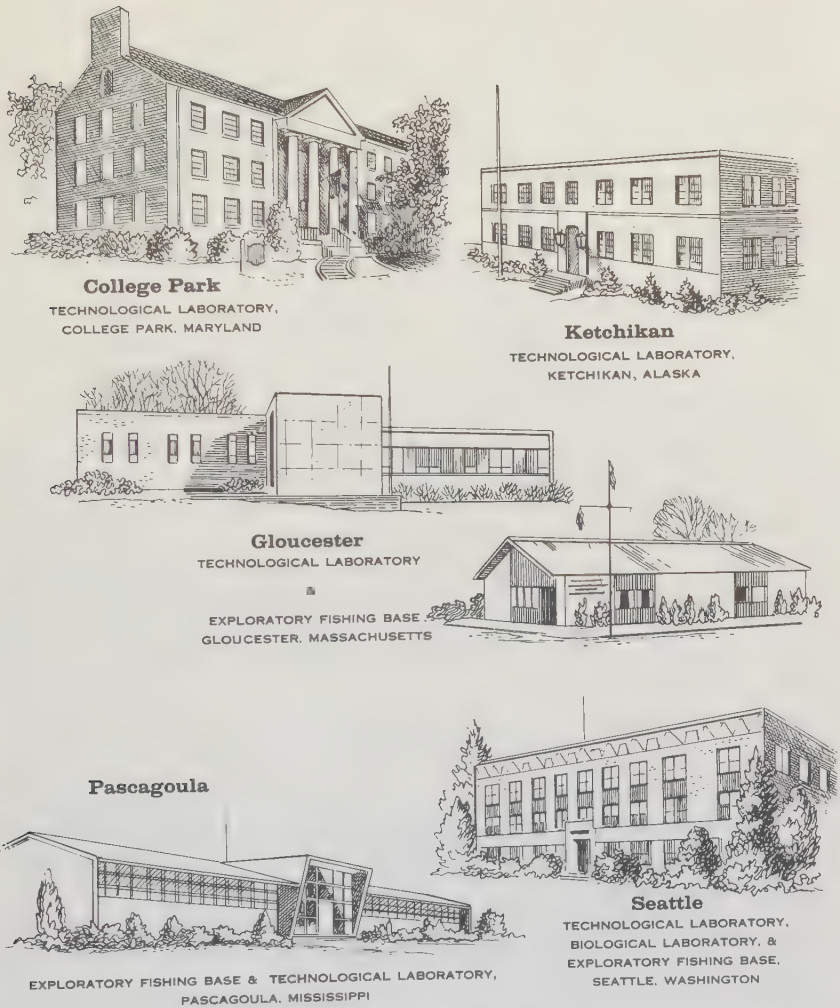

FIGURE 8.—Bureau of Commercial Fisheries exploratory fishing and gear research and technological laboratories, 1964.

Improvements or additions to existing installations were made or are under way. Rehabilitation of the lighthouse and dock at St. Simons Island, Ga., to house an exploratory fishing and gear research station was completed. Construction of dock facilities and a salt–water system for the Bureau's Biological Laboratory at Auke Bay, Alaska, begun in December 1962, is nearing completion.

The vessel construction program also made good progress. The vessel *David Starr Jordan* is under construction and is expected to be delivered in the summer of 1965. This vessel is to replace the *Black Douglas* and

will be used for oceanographic research in the eastern Pacific in conjunction with the Bureau's Biological Laboratory at La Jolla.

Several contracts for designing vessels were given. The replacement for the vessel *Delaware* was contracted for at a cost of $1,136,710. This vessel is for exploratory fishery and gear research in the North Atlantic. The design of the Galveston vessel is nearing completion and is expected to be advertised in fiscal year 1965. This vessel is planned for inshore oceanographic research on the occurrence of red tide and the movements and survival of young fishes, shrimp, and other marine species. Another contract was for converting the *Undaunted,* a vessel similar to the *Geronimo.* When converted, the *Undaunted* will be assigned to the Tropical Atlantic Oceanography Investigations of the Bureau's Biological Laboratory, Washington, D.C. The third contract was for designing the *Oregon* replacement, a vessel attached to the Bureau's Exploratory Fishing Base, Pascagoula, Miss., and is expected to be bid in fiscal year 1965. Other contracts were for designing a Great Lakes hydrobiological vessel for the Bureau's Biological Laboratory, Ann Arbor, Mich.; an exploratory fishing vessel for the Alaska Region; an inshore vessel for the Bureau's Biological Laboratory, Boothbay Harbor, Maine; a fishing gear research vessel to be based in Seattle; and a vessel to replace the *Mackinaw*, which was lost while doing inshore research in Alaska.

No bids were received for constructing the North Pacific research vessel, and a readvertisement will be issued in fiscal year 1965. This vessel will permit all-season high-seas fishery and oceanographic research in conjunction with the Bureau's Biological Laboratory in Seattle.

The Bureau's principal fishery research vessels are shown in figures 9 and 10.

Publications

Publications are the principal means by which the Bureau informs the fishing industry and general public of continuing progress in its biological, chemical, economic, engineering, marketing, and statistical activities.

Because the Bureau's activities are many and varied, its publications interest several groups of people. Fifty percent of the papers deal with statistics and, therefore, are of special interest to the fishing industry and fishery research workers; 15 percent are for commercial and industrial audiences; 30 percent are contributions to scientific knowledge, particularly relating to fisheries; and the remaining 5 percent present popular information for the general public, especially school children.

Exclusive of the Fishery Products Reports (6,159 p.), which the 7 Market News Service field offices issued five times a week, the Bureau

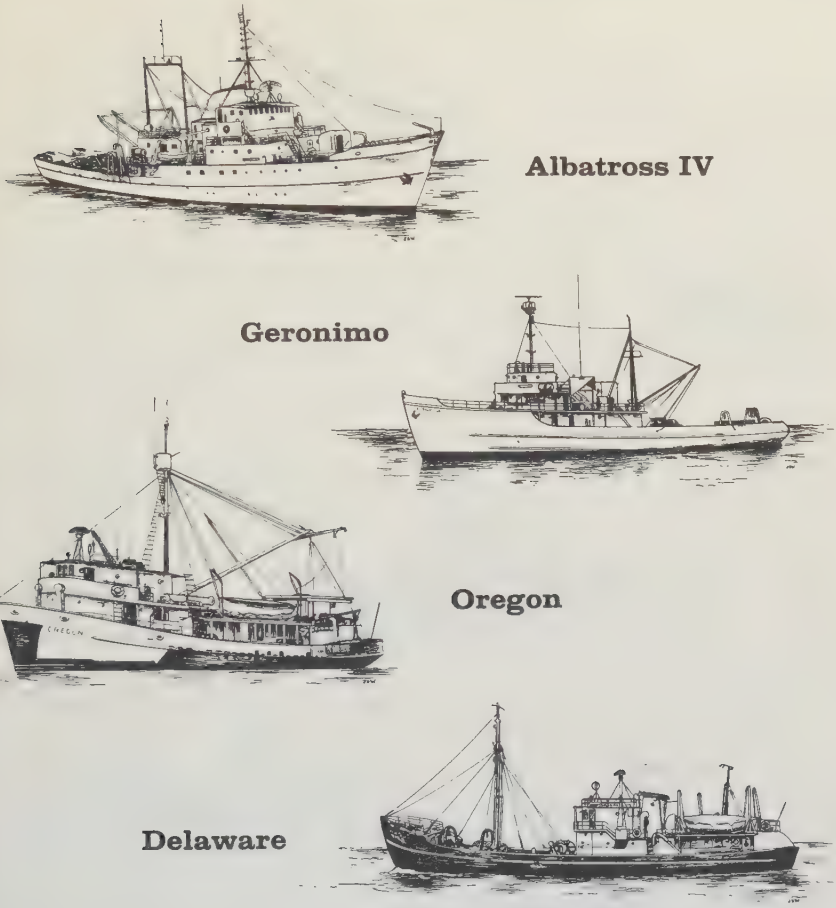

FIGURE 9.—Bureau of Commercial Fisheries principal research vessels operating in the Atlantic in 1964.

sponsored 815 publications (13,081 p.) in 1964. In the Fish and Wildlife Service series 544 reports (10,336 p.) were published. The remaining 271 papers (2,745 p.) appear in non–Service technical and trade journals. Bureau employees wrote most of the papers; employees of research institutions under contract to the Bureau and unpaid collaborators wrote the others.

Appendix G of this report describes the Bureau's series of publications and partly lists the publications issued in 1964.

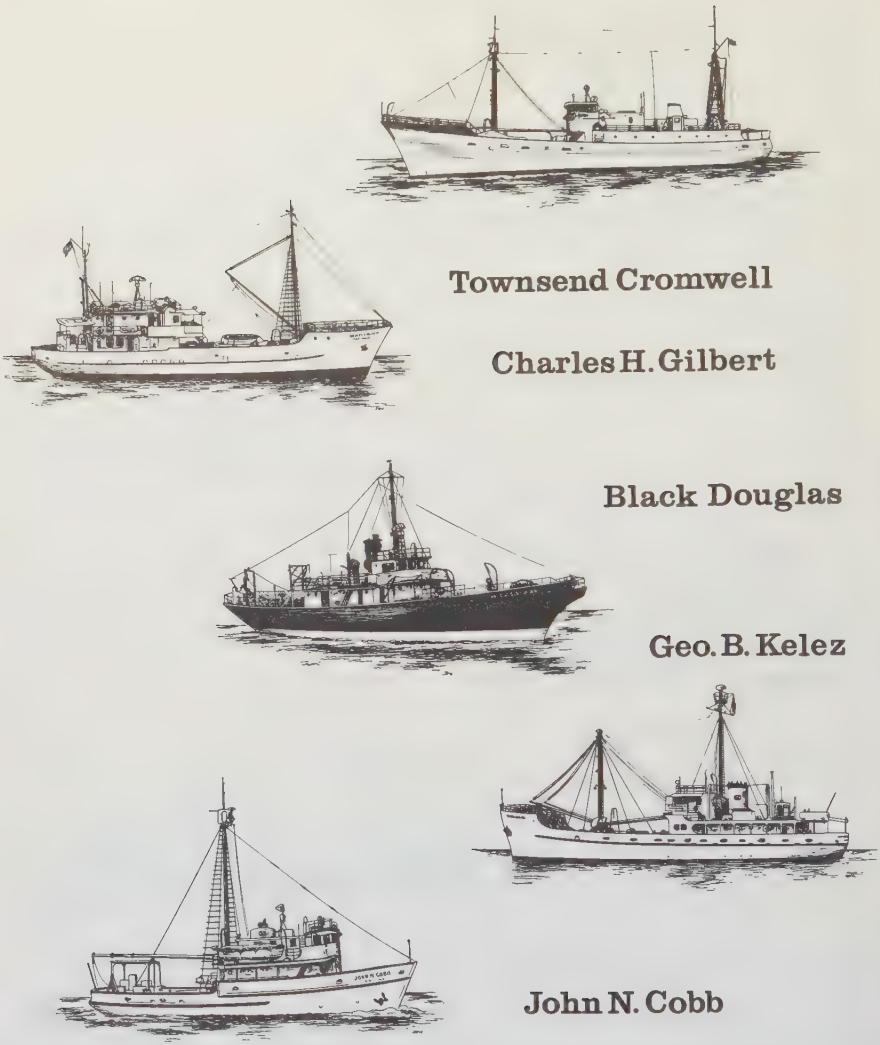

FIGURE 10.—Bureau of Commercial Fisheries principal research vessels operating in the Pacific in 1964.

Appendix A—Fisheries of the United States

A–1.—*Employment, fishing craft, and establishments, calendar years 1964 and 1963*

	1964	1963
	Number	*Number*
Persons employed:		
Fishermen	127,875	128,470
In fishery wholesaling and manufacturing establishments	83,976	87,252
Total	211,851	215,722
Craft used:		
Fishing:		
Vessels (5-net tons and over)	11,808	11,928
Motor boats	60,945	62,090
Other boats	3,659	3,955
Total	76,412	77,973
Fishing vessels, documentations issued and canceled:		
First documentation	488	569
Redocumentation	15	21
Documents canceled	−442	−396
Net gain	61	194
Fishery shore establishments:		
Pacific Coast States	600	593
Atlantic Coast and Gulf States	2,848	2,918
Great Lakes and Mississippi River States	656	667
Hawaii	17	16
Total	4,121	4,194

A–2.—*U.S. catch of certain species, calendar years 1964, 1963, and record year*

Species	1964		1963		Record catch	
	Million Pounds	*Million Dollars*	*Million Pounds*	*Million Dollars*	*Year*	*Million Pounds*
Menhaden	1,570	22	1,816	22	1962	2,348
Salmon	352	56	294	49	1936	791
Tuna [1]	306	39	322	40	1950	391
Crabs	270	24	252	21	1964	270
Shrimp	212	70	240	70	1954	268
Haddock	133	12	124	12	1929	294
Flounders, Atlantic	129	12	125	12	1964	129
Herring, sea	116	2	194	2	1937	317
Whiting	94	2	93	2	1957	133
Jack mackerel	90	2	96	2	1952	147
Ocean perch, Atlantic	89	4	108	5	1951	258
Clams	64	15	63	14	1964	64
Oysters	61	28	58	27	1908 [2]	152
Mullet	42	2	43	2	1902	43
Cod, Atlantic	39	3	42	3	1880	294
Scup	39	3	42	3	1960	49
Halibut, Pacific	35	6	46	7	1915	67
Lobsters, northern	31	20	30	17	1960	31
Mackerel, Pacific	27	1	40	1	1935	147
Scallops, sea	17	9	20	9	1961	27
Snapper, red	14	4	13	4	1902	23
Pollock	13	1	15	1	1938	41
Sardine, Pacific	13	1	7	(3)	1936	1,502
Striped bass	9	1	9	1	1961	9
Other	[4] 776	[4] 50	755	51	.....	.....
Total	[4] 4,541	[4] 389	4,847	377		

[1] Does not include landings of tuna by U.S. vessels in Puerto Rico.
[2] First year in which an oyster survey was made in all areas.
[3] Less than $500,000.
[4] Preliminary.

A–3.—*Summary of manufactured fishery products, by quantity and value, calendar years 1964 and 1963*

Item	1964		1963	
	Quantity	Value	Quantity	Value
	Thousand Pounds	*Thousand Dollars*	*Thousand Pounds*	*Thousand Dollars*
Packaged products, fresh and frozen:				
Fish:				
Not breaded:				
Fillets and steaks, raw:				
Flounder	48,554	17,457	45,894	16,426
Groundfish, including ocean perch	75,166	24,286	83,419	26,408
Halibut	9,560	4,560	9,192	4,647
Other (including whale meat for animal feeding)	39,130	13,688	34,123	12,055
Total	172,410	59,991	172,628	59,536
Breaded, raw and cooked:				
Sticks	73,574	29,986	79,300	31,589
Fillets, portions and steaks	109,416	38,373	95,448	34,483
Shellfish:				
Not breaded:				
Shrimp	98,989	89,992	96,020	81,299
Other	115,018	90,508	98,358	79,817
Total	214,007	180,500	194,378	161,116
Breaded:				
Shrimp	91,333	63,388	76,216	53,527
Other	11,994	10,182	16,423	13,358
Total	103,327	73,570	92,639	66,885
Specialties, fish and shellfish	35,758	27,946	35,992	22,422
Total fresh and frozen	708,492	410,366	670,385	376,031
Canned:				
Fish and shellfish for human consumption:				
Tuna	349,834	217,585	326,712	201,588
Salmon	180,441	95,761	158,153	87,963
Sardines:				
Maine (sea herring)	20,259	7,584	37,890	13,244
Pacific	5,438	1,030	2,568	685
Mackerel	48,187	6,760	57,395	7,603
Clam products and specialties	63,485	19,146	62,660	19,000
Shrimp and specialties	10,327	13,231	16,328	19,733
Oysters and specialties	11,486	7,459	14,483	8,108
Squid	10,303	887	7,167	621
Other	42,354	21,583	45,581	22,784
Total for human consumption	742,114	391,026	728,937	381,329
Bait and animal food:				
Animal food	352,400	43,471	306,189	39,042
Salmon eggs for bait	1,051	2,163	783	1,236
Total bait and animal food	353,451	45,634	306,972	40,278
Total canned	1,095,565	436,660	1,035,909	421,607
Cured fish and shellfish:				
Salted	37,015	16,735	37,732	16,159
Smoked	27,213	29,732	29,470	30,055
Dried fish and shellfish, and lute fisk	[1] 1,291	1,316	[1] 1,612	2,039
Total cured	65,519	47,783	68,814	48,253
Industrial products:				
Meal and scrap	470,504	28,039	511,814	30,235
Oil, body and liver	180,198	13,297	185,827	10,853
Fish solubles and homogenized condensed fish	186,592	5,662	214,804	6,753
Oyster shell lime and poultry grit	725,086	4,915	797,166	5,480
Marine pearl shell and mussel shell buttons	[2] 634	1,277	[2] 781	1,521
Other	.....	16,721	.....	13,759
Total industrial products	.....	69,911	.....	68,601
Grand total	.....	964,720	.....	914,492

[1] Includes freeze–dried products.
[2] Number of gross.

A–4.—*Foreign trade in fishery products, by quantity and value, calendar years 1964 and 1963*

Item	1964		1963	
	Quantity	Value	Quantity	Value
Imports:				
Edible:	*Thousand Pounds*	*Thousand Dollars*	*Thousand Pounds*	*Thousand Dollars*
Fresh or frozen:				
Fresh-water (not fillets)	36,175	12,612	37,329	12,986
Salt-water (not fillets)	499,290	73,876	393,362	60,991
Groundfish and ocean perch fillets	246,569	57,548	231,768	50,328
Other fillets	73,554	26,126	68,869	23,772
Shrimp	151,168	104,355	150,138	101,911
Lobsters:				
Common	20,386	16,041	21,847	16,259
Spiny	35,104	43,547	34,048	38,214
Scallops	16,108	8,491	13,342	6,306
Other shellfish	9,209	3,199	11,642	4,477
Canned:				
Anchovies	5,507	4,131	4,171	2,529
Bonito and yellowtail	4,990	1,363	5,865	1,617
Salmon	236	128	1,250	607
Sardines	44,635	13,441	41,548	12,994
Tuna	54,647	23,273	57,494	23,864
Crab meat	4,550	5,358	5,296	6,370
Lobsters	3,010	6,963	2,643	4,818
Oysters and oyster juice	7,969	2,876	8,463	3,101
Other	28,119	14,444	25,776	12,195
Cured:				
Dried, pickled, or salted:				
Cod, haddock, hake, pollock, and cusk	41,399	9,368	43,920	9,457
Herring	27,296	3,880	25,501	3,589
Other	3,082	1,036	2,878	922
Smoked or kippered	3,308	872	4,172	1,022
Other	1,788	746	5,655	1,599
Total edible	1,318,099	433,674	1,196,977	399,928
Nonedible:				
Fish and marine animal oils	[1] 10,070	7,257	[1] 10,791	8,160
Fish meal and scrap	[2] 439	44,181	[2] 376	37,039
Fish solubles	[2] 5	366	[2] 7	494
Other	.....	78,765	.....	55,091
Total nonedible	.....	130,569	.....	100,784
Grand total imports	.....	564,243	.....	500,712
Exports of domestic products:				
Edible:				
Fresh or frozen	43,780	16,223	30,261	13,636
Canned:				
Mackerel	8,588	1,140	4,940	681
Salmon	20,924	14,852	10,228	8,239
Sardines	3,265	729	3,639	716
Shrimp	3,692	3,664	3,199	3,054
Squid	7,005	662	8,048	742
Other	3,939	3,012	2,609	2,010
Total canned	47,413	24,059	32,663	15,442
Cured	2,015	1,118	963	711
Other	1,627	1,478	858	587
Total edible	94,835	42,878	64,745	30,376
Nonedible:				
Fish and marine animal oils	151,469	13,096	262,342	15,636
Other	.....	8,230	.....	10,593
Total nonedible	.....	21,326	.....	26,229
Grand total exports	.....	64,204	.....	56,605

[1] In thousand gallons.
[2] In thousand tons.

Appendix B—New Legislation

Commercial Fisheries Research and Development Act of 1964

16 U.S.C. 779–779g; 16 U.S.C. 742c(e)

Authorizes the Secretary of the Interior to cooperate with the States through their respective State agencies which regulate commercial fisheries in carrying out projects designed for research on and development of the commercial fisheries resources of the Nation. Puerto Rico, American Samoa, the Virgin Islands, and Guam are treated as States. The Act contains four different authorizations.

Section 4(a) authorizes the appropriation of $5,000,000 annually for 5 years which is to be apportioned annually among the States according to a formula based upon the amount of commercial fishery activity in each State. The funds are to be available for obligation for 2 years and if not used revert to the U.S. Treasury. Projects approved under this subsection will be financed by the Federal Government and by the State Government and the share of the Federal Government cannot exceed 75 percent.

Section 4(b) authorizes the appropriation of $400,000 for each of the first 2 years of the program and $650,000 for each of the last 3 years of the program. This money is to be made available to the States in amounts to be determined by the Secretary for the purposes of the Act. The Secretary must give preference to those States in which he determines there is a commercial fishery failure due to a resource disaster arising from natural or undetermined causes. Under this subsection the money may be used for any purpose the Secretary determines to be appropriate to restore the fishery affected by such failure or to prevent a similar failure in the future. Projects approved under this subsection may be financed entirely from Federal funds and the money appropriated is available until expended.

Section 4(c) authorizes the appropriation of $100,000 annually for 5 years. The funds are to be made available to States in amounts to be determined by the Secretary for developing a new commercial fishery. The funds are available for 1 year and projects approved under this subsection are to be financed entirely from Federal funds.

The fourth authorization is contained in section 9 of the Act and is not related to the preceding authorizations. The section amends section 4 of the Fish and Wildlife Act of 1956 to permit the fishery loan fund established by that Act to be used for loans to Alaska fishermen for charter of fishing vessels for temporary replacement pending the repair or the permanent replacement of vessels damaged or lost in the earthquake disaster of March 27, 1964. The charter loans are to be repaid only from net profits of the operation of the chartered vessels after deducting a reasonable amount for salary of the fishermen chartering the vessels. This fourth authorization expires June 30, 1966.

78 Stat. 197; Public Law 88–309; Act of May 20, 1964.

Medical Care for Fishing Vessel Owners

42 U.S.C. 249(a)(8)

Amends section 322 of the Public Health Service Act (42 U.S.C. 249) by adding an additional class of persons entitled to medical, surgical, and dental treatment and hospitalization without charge at hospitals and other stations of the Public Health Service. Those added are: Persons who own vessels registered, enrolled, or licensed under the maritime laws of the United States, who are engaged in commercial fishing operations, and who accompany such vessels on such fishing operations, and a substantial part of whose services in connection with such fishing operations are comparable to services performed by seamen employed on such vessel or on vessels engaged in similar operations.

78 Stat. 398; Public Law 88–424; Act of August 13, 1964.

Prohibition of Fishing in United States Territorial Waters by Foreign–Flag Vessels

16 U.S.C. 1081–1085

Prohibits fishing in U.S. territorial waters by foreign–flag vessels and provides for enforcement of the prohibition and statutory penalties for violations. The law also prohibits foreign–flag vessels from taking any Continental Shelf fishery resource which appertains to the United States. As defined in the Act, such resources are limited to the sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil of the Continental Shelf. Exceptions are provided for either by international treaty or by specific authority from the Secretary of the Treasury under certain conditions after approval by the Secretaries of State and Interior and the individual State concerned.

78 Stat. 194; Public Law 88–308; Act of May 20, 1964.

United States Fishing Fleet Improvement Act

46 U.S.C. 1401–1413

Amends the fishing vessel construction differential subsidy law (Public Law 86–516, 46 U.S.C. 1401–1413) which provided that no application could be accepted after June 12, 1963, by extending the term of the law to June 30, 1969. In addition to extending the term of the law, the amendment raises the maximum subsidy from 33⅓ percent to 50 percent and eliminates the necessity for a finding of injury from imports. The new law requires the vessel to be of advanced design, which will enable it to operate in expanded areas, and to be equipped with the most modern gear available. Public hearings are to be held on each application to determine that the vessel will not be operated in a fishery where such operation would cause economic hardship to fishing vessel operators already operating in that fishery.

78 Stat. 614; Public Law 88–498; Act of August 30, 1964.

Appendix C—Fisheries Loan Fund

C–1.—*Status of fisheries loan fund, June 30, 1964*

Funds appropriated		$13,000,000
Principal collected	$8,408,000	
Interest collected and accrued	1,740,000	
Total collected		10,148,000
Total		23,148,000
All expenses to end of fiscal year 1964	1,635,377	
Loans approved	15,585,978	
Total		17,221,355
Balance		5,926,645

C–2.—*Cumulative totals, fiscal years 1963 and 1964, and totals, fiscal year 1964*

	Cumulative total				Total fiscal year 1964	
	As of June 30, 1963		As of June 30, 1964			
	Number	*Amount*	*Number*	*Amount*	*Number*	*Amount*
Applications received	1,268	$34,599,601	1,487	$39,840,256	219	$5,240,655
Applications approved	673	15,472,951	791	17,802,763	118	2,329,812
Applications declined	337	8,476,814	384	9,199,844	47	723,030
Applications ineligible	103	2,741,166	120	3,070,575	17	329,409
Being processed	8	303,544	21	1,406,700	13	1,103,156

C–3.—*Cumulative totals, fiscal years 1963 and 1964, and totals, fiscal year 1964*

	Cumulative total				Total fiscal year 1964	
	As of June 30, 1963		As of June 30, 1964			
	Number	*Amount*	*Number*	*Amount*	*Number*	*Amount*
Northeast:						
Applications received	315	$10,135,031	349	$10,689,425	34	$ 554,394
Applications approved	165	4,499,337	183	4,805,777	18	306,440
California:						
Applications received	184	10,440,750	206	12,605,320	22	2,164,570
Applications approved	111	4,790,511	124	5,703,864	13	913,353
Gulf & South Atlantic:						
Applications received	314	7,949,568	334	8,353,092	20	403,524
Applications approved	122	2,823,874	125	2,875,813	3	51,939
Pacific Northwest:						
Applications received	223	3,854,802	268	4,594,549	45	739,747
Applications approved	138	2,216,702	161	2,628,492	23	411,790
Alaska:						
Applications received	174	1,441,591	268	2,796,511	94	1,354,920
Applications approved	110	845,739	170	1,488,029	60	642,290
Great Lakes:						
Applications received	34	384,789	38	408,289	4	23,500
Applications approved	11	89,920	12	93,920	1	4,000
Hawaii:						
Applications received	23	391,070	23	391,070	0	0
Applications approved	15	205,068	15	205,068	0	0
Puerto Rico:						
Applications received	1	2,000	1	2,000	0	0
Applications approved	1	1,800	1	1,800	0	0

C–4.—*Authorized use of loan proceeds, percentage by area*
[From beginning of program through fiscal year 1964]

	Debt payment	Improvements	Other
New England and Middle Atlantic	49	50	1
South Atlantic and Gulf	67	31	2
California	43	54	3
Pacific Northwest	34	65	1
Great Lakes	32	68	0
Alaska	16	83	1
Hawaii and Puerto Rico	46	50	4
Total	44	54	2

C–5.—*Number of loan applications received monthly, fiscal years 1957–64*

	1957	1958	1959	1960	1961	1962	1963	1964
July	.....	17	9	15	8	19	6	5
August	.....	17	12	13	10	16	7	2
September	.....	14	10	9	7	16	11	21
October	.....	12	7	16	6	14	13	14
November	.....	18	13	9	19	26	7	16
December	88	11	13	15	21	14	8	15
January	16	14	10	16	18	29	5	12
February	41	18	12	27	26	19	12	13
March	40	22	15	28	13	19	11	18
April	22	22	14	13	18	16	12	48
May	28	11	10	19	31	9	2	36
June	30	9	12	10	7	11	5	19
Total	265	185	137	190	184	208	99	219

C–6.—*Amounts applied for monthly, fiscal years 1957–64*

	1957	1958	1959	1960	1961	1962	1963	1964
July		$274,524	$251,571	$830,182	$134,196	$532,305	$141,780	$136,794
August		931,110	363,000	234,465	275,972	297,614	223,021	11,718
September		607,851	385,517	465,610	176,781	438,773	117,243	233,864
October		204,635	62,532	305,150	195,095	145,443	132,107	243,298
November		375,583	153,559	124,905	428,011	296,877	144,267	296,669
December	$2,533,020	160,670	331,502	198,161	425,076	182,876	275,415	350,103
January	377,485	520,323	153,501	344,197	203,752	907,519	68,100	1,087,030
February	1,458,748	305,318	115,000	554,425	665,798	195,612	111,670	1,001,900
March	2,563,703	862,325	185,069	698,063	692,766	390,959	119,470	194,515
April	629,131	336,888	189,871	226,542	426,453	321,438	102,661	830,592
May	2,276,774	642,025	185,869	1,003,874	877,990	86,911	23,000	569,175
June	948,437	224,652	291,990	343,372	216,160	262,927	132,444	285,097
Total	10,787,298	5,445,904	2,668,971	5,328,946	4,718,050	4,059,254	1,591,178	5,240,655

Appendix D—Organizations With Which the Bureau Had Research and Development Contracts and Grants in 1964

Organization	*Location*
Alaska Department of Education	Juneau, Alaska
Alaska Department of Fish and Game	Juneau, Alaska
American Scientific Corporation	Alexandria, Va.
Bio Dynamics, Inc.	Cambridge, Mass.
California Department of Fish and Game	Sacramento, Calif.
California, University of	San Diego, Calif.
California, University of	Berkeley, Calif.
Columbia University	New York, N.Y.
Cornell University	Ithaca, N.Y.
Delaware, University of	Newark, Del.
Duke University	Durham, N.C.
Esso Research and Engineering Co.	Linden, N.J.
Fish Commission of Oregon	Portland, Oreg.
George Washington University	Washington, D.C.
Great Lakes Fishery Commission	Ann Arbor, Mich.
Hawaii, University of	Honolulu, Hawaii
Hiram College	Hiram, Ohio
Idaho State Department of Fish and Game	Boise, Idaho
Idaho, University of	Moscow, Idaho
Iowa State University	Ames, Iowa
Johns Hopkins University	Baltimore, Md.
Maryland, University of	College Park, Md.
Massachusetts Institute of Technology	Cambridge, Mass.
Massachusetts, University of	Amherst, Mass.
Miami, University of	Coral Gables, Fla.
Michigan, University of	Ann Arbor, Mich.
National Fisheries Institute	Washington, D.C.
North Carolina, University of	Chapel Hill, N.C.
North Dakota State University	Fargo, N.Dak.
Oregon State University	Corvallis, Oreg.
Oyster Institute of North America	Sayville, Long Island, N.Y.
Pennsylvania Fish Commission	Harrisburg, Pa.
Pennsylvania State University	University Park, Pa.
Pennsylvania, University of	Philadelphia, Pa.
Philadelphia General Hospital	Philadelphia, Pa.
Puerto Rico, University of	Mayaguez, P.R.
Rhode Island, University of	Kingston, R.I.
Rutgers University	New Brunswick, N.J.
Straza Industries	El Cajon, Calif.
Texas A. and M. University	College Station, Tex.
Trenton Junior College	Trenton, N.J.
United States Testing Company	Hoboken, N.J.
Virginia, University of	Gloucester Point, Va.
Washington State Department of Fisheries	Olympia, Wash.
Washington State Department of Game	Olympia, Wash.

Organization	*Location*
Washington, University of (Department of Economics)	Seattle, Wash.
Washington, University of (Fisheries Research Institute)	Seattle, Wash.
Wisconsin, University of	Madison, Wis.
Woods Hole Oceanographic Institution	Woods Hole, Mass.

Appendix E—Budget for Fiscal Year 1964

Function	Appropriations								Other funds		Total
	Management and investigations of resources	Special foreign currency	Construction	Construction of fishing vessels	General administrative expenses	Administration of Pribilof Islands	Payment to Alaska from Pribilof Islands receipts	Fishery promotion and development[1]	Contributed funds	Reimbursements	
	Thousand Dollars	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*	*Thousand Dollars*
Management	393										393
Marketing and technology	4,099	125						2,101	591	529	7,445
Research	9,712	175						2,563	867	510	13,827
Research on fish migration over dams	1,497							250		109	1,856
Fishing vessel mortgage insurance	42										42
Columbia River fishery facilities	2,090		988							105	3,183
Construction of fishery facilities			4,112								4,112
Construction of fishing vessels				750							750
General administrative services					653			392	38	23	1,106
Administration of Pribilof Islands						2,178				60	2,238
Fur seal research						290				3	293
Payment to Alaska from Pribilof Islands receipts							589				589
Fisheries Advisory Committee								36			36
Total	17,833	300	5,100	750	653	2,468	589	5,342	[2] 1,496	[3] 1,339	35,870

[1] Funds made available under Public Law 466, 83d Cong. (known as the Saltonstall–Kennedy Act of 1954).
[2] Includes $757,000 from Great Lakes Fishery Commission and $553,000 for inspection and grading fishery products.
[3] Reimbursements include funds from the following: $573,000 AEC; $331,000 Bureau of Sport Fisheries and Wildlife; $102,000 Corps of Engineers; $102,000 AID; $70,000 CIA; $39,000 State of Washington; $47,000 Japan and Canada.

Appendix F—Physical Properties

F–1.—*Principal laboratories and installations, calendar year 1964*

Location	Type	Principal use	Gross valuation [1]
Alaska:			
Auke Bay	Biological Laboratory	Biological research	$436,000
Juneau	Exploratory Fishing and Gear Research Base, warehouse and shops.	Exploratory fishing and gear research, vessel maintenance, loans and grants.	[2] 145,000
Ketchikan	Technological Laboratory	Technological research	195,000
Pribilof Islands	Fur seal processing facilities and native villages.	Management of Alaska fur seals.	2,912,000
California:			
La Jolla	Biological Laboratory	Biological research	[3]
San Diego	do	do	[3]
Stanford	do	do	[3]
Connecticut, Milford	do	do	92,000
District of Columbia:			
Navy Yard Annex	do	do	[3]
U.S. National Museum	Ichthyological Laboratory	do	[3]
Florida:			
Gulf Breeze	Biological Laboratory	do	62,000
St. Petersburg Beach	Office of Loans and Grants	Loans and grants	[3]
Georgia, Brunswick	Biological Laboratory	Biological research	[3]
Hawaii, Honolulu	do	Biological research, loans and grants, statistics.	315,000
Maine, Boothbay Harbor	do	Biological research	[2] 211,000
Maryland:			
College Park	Technological Laboratory	Technological research, home economics.	84,000
Oxford	Biological Laboratory	Biological research, statistics.	207,000
Massachusetts:			
Boston	Office of Loans and Grants	Loans and grants	[3]
Gloucester	Technological Laboratory	Technological research, fishery products inspection.	334,000
Do	Exploratory Fishing and Gear Research Base.	Exploratory fishing and gear research.	65,000
Woods Hole	Biological Laboratory	Biological research	1,029,000
Michigan, Ann Arbor	Biological Laboratory, Technological Station, Exploratory Fishing and Gear Research Station.	Biological and technological research, exploratory fishing and gear research, marketing development, statistics.	[3]
Mississippi, Pascagoula	Exploratory Fishing and Gear Research Base, Technological Laboratory.	Exploratory fishing and gear research, market development, biological and technological research.	370,000
North Carolina, Beaufort	Biological Laboratory	Biological research, statistics	595,000
Texas, Galveston	do	Biological research	351,000
Washington, Seattle	Biological Laboratories, Technological Laboratory, Exploratory Fishing and Gear Research Base, dock and warehouse.	Biological and technological research, exploratory fishing and gear research, Pribilof Islands supply, fishery products inspection.	[2] 142,000
Puerto Rico, Mayaguez	Technological Laboratory	On loan to University of Puerto Rico.	

[1] Figures shown are original acquisition or construction costs.

[2] Installations at this location are both owned and leased by Bureau of Commercial Fisheries.

[3] Installation not owned by Bureau of Commercial Fisheries. Includes property held under leases, cooperative agreements, and use permits.

F–2.—*Minor field research stations, market news offices, exploratory fishing stations, market development offices, and statistical offices, calendar year 1964*

Location	Type	Principal use	Gross valuation [1]
Alabama, Bayou LaBatre	Statistical and Market News Field Office.	Statistics and market news reporting.	[2]
Alaska:			
Brooks Lake	Field Research Station	Biological research	$44,000
Juneau	Statistical Field Office	Statistics	[3]
Karluk Lake	Field Research Station	Biological research	27,000
Kasitsna Bay	do	do	12,000
Little Port Walter	do	do	158,000
Olsen Bay	do	do	7,000
St. Paul Island	do	do	[4]
Traitors Cove	do	do	8,000
California:			
Mill Creek	Field Research Station	Biological research	29,000
San Pedro	Market News and Statistics Office.	Market news and statistics reporting.	[2]
San Francisco	Marketing Office	Marketing	[2]
Terminal Island	Marketing Office and Technological Station.	Technological research, fishery products inspection.	[2]
Tiburon	Field Research Station	Biological research	[2]
Florida:			
Apalachicola	Statistical and Market News Field Office.	Statistics and market news reporting.	[2]
Fort Myers	do	do	[2]
Green Cove Springs	Field Research Station	Biological research	[2]
Key West	Statistical and Market News Field Office.	Statistics and market news reporting.	[2]
Miami	Statistical Field Office	Statistics and biological research.	[2]
Panama City	Exploratory Fishing and Gear Research Station.	Exploratory fishing and gear research.	[2]
St. Petersburg Beach	Field Research Station and Fishery Products Inspection Office.	Biological research, fishery products inspection, marketing.	[2]
Tampa	Statistical and Market News Field Office.	Statistics and market news reporting.	[2]
Georgia:			
Atlanta	Marketing Office	Marketing	[2]
Brunswick	Statistical Field Office	Statistics	[2]
St. Simons Island	Exploratory Fishing Station	Exploratory fishing and gear research.	[2]
Idaho:			
Boise	Field Research Station	Biological research	[2]
Weiser	do	do	[2]
Illinois:			
Chicago	Market News Office, Fishery Products Inspection Office.	Market news reporting, fishery products inspection.	[2]
Do	Marketing Office	Marketing	[2]
Louisiana:			
Empire	Statistical Field Office	Statistics	[2]
Houma	Statistical and Market News Field Office.	Statistics and market news reporting.	[2]
Morgan City	do	do	[2]
New Orleans	Market News Office, Statistical Field Office.	do	[2]
Port Sulphur	Statistical Field Office	Statistics	[2]
Maine:			
Portland	Field Office	Statistics, market news, biological research.	[2]
Rockland	do	do	[2]
West Boothbay Harbor	Statistical Field Office	Statistics	[2]
Maryland:			
Baltimore	Market News Office, Marketing.	Market news reporting, marketing.	[2]
Salisbury	Statistical Field Office	Statistics	[2]
Massachusetts:			
Boston	Market News Office, Marketing.	Market news reporting, statistics, marketing.	[2]
Gloucester	Field Offices	Statistics, biological research, market news, fishery products inspection.	[2]
New Bedford	Field Office	Statistics, biological research, market news reporting.	[2]
Provincetown	Statistical Field Office	Statistics, market news reporting.	[2]

See footnotes at end of table.

F–2.—*Minor field research stations, market news offices, exploratory fishing stations, market development offices, and statistical offices, calendar year 1964*—Continued

Location	Type	Principal use	Gross valuation [1]
Michigan:			
Hammond Bay	Field Research Station	Biological research	(2)
Ludington	do	do	(2)
Marquette	do	do	(2)
Northville	do	do	(2)
Mississippi:			
Ocean Springs	Statistical Field Office	Statistics and market news reporting.	(2)
Pascagoula	Field Research Station	Biological research, marketing.	(2)
New Jersey, Toms River	Statistical Field Office	Statistics	(2)
New York:			
Bayport	do	do	(2)
New York City	Market News Office, Marketing, Fishery Products Inspection Office.	Market news reporting, marketing, fishery products inspection.	(2)
Ohio:			
Cleveland	Marketing Office	Marketing	(2)
Sandusky	Field Research Station	Biological research	(2)
Oregon:			
Eugene	do	do	(2)
Portland	do	do	(2)
Rhode Island:			
Point Judith	Field Station	Statistics, biological research.	(2)
Warren	Statistical Field Office	Statistics	(2)
South Carolina, Charleston	do	do	(2)
Texas:			
Aransas Pass	Market News and Statistical Field Office.	Statistics and market news	(3)
Brownsville	Market News and Statistical Field Office, Fishery Products Inspection Office.	Statistics and market news, fishery products inspection.	(2)
Dallas	Marketing Office	Marketing	(2)
Freeport	Statistical Field Office	Statistics	(2)
Galveston	Market News and Statistical Field Office.	Statistics and market news	(2)
Port Arthur	do	do	(2)
Port Isabel	do	do	(2)
Virginia:			
Franklin City	Field Research Station	Biological research	(2)
Hampton	Market News Office	Market news reporting	(2)
Portsmouth	Statistical Field Office	Statistics	(2)
Weens	do	do	(2)
Washington:			
North Bonneville	Field Research Station	Biological research	(2)
Seattle	Market News and Statistical Office.	Market news reporting, statistics, loans and grants.	(2)
Do	Marketing Office	Marketing	(2)
Wisconsin:			
Ashland	Field Research Station	Biological research	(2)
La Crosse	Statistical Field Office	Statistics	(2)

[1] Figures shown are original acquisition or construction costs.
[2] Installation not owned by Bureau of Commercial Fisheries. Includes property held under leases, cooperative agreements, and use permits.
[3] Installations at this location are both owned and leased by Bureau of Commercial Fisheries.
[4] Included in Pribilof Islands.

F–3.—*Bureau of Commercial Fisheries vessel fleet, calendar year 1964*

Name of vessel	Home port	Length (feet)	Year built	Cost or estimated value	Horsepower	Mission
FSR–791	Seattle, Wash	222	1954	$2,200,000	1,500	Transportation of supplies and personnel to the Pribilof Islands fur seal stations.
Albatross IV	Woods Hole, Mass.	187	1962	2,000,000	1,100	Fishery and biological research studies; oceanographic studies in Atlantic waters.
Geo. B. Kelez	Seattle, Wash	176	1944	805,000	1,000	High-seas salmon investigation and oceanography.

F 3.—*Bureau of Commercial Fisheries vessel fleet, calendar year 1964*—Continued

Name of vessel	Home port	Length (feet)	Year built	Cost or estimated value	Horsepower	Mission
Townsend Cromwell.	Honolulu, Hawaii	158	1963	$1,049,935	800	Pacific oceanography; tuna biology, behavior, and distribution.
Black Douglas...	San Diego, Calif..	152	1926	75,000	325	Biology, distribution, spawning of the Pacific sardine; abundance and life history studies of other commercial species.
Delaware	Gloucester, Mass.	147	1937	302,473	735	Exploratory fishing and biological studies on the groundfishes and sea scallops; gear research.
Geronimo.	Washington, D.C.	143	1944	1,000,000	1,850	Fishery oceanographic research.
Undaunted	Washington, D.C.	143	1944	1,000,000	1,850	Fishery–oceanographic research.
Charles H. Gilbert.	Honolulu, Hawaii	123	1952	409,890	640	Pacific oceanography; tuna biology, behavior, and distribution.
Oregon	Pascagoula, Miss.	100	1950	300,000	600	Exploratory fishing for shrimp, tuna, and other potentially commercial species; gear research.
John N. Cobb.	Seattle, Wash....	93	1950	235,392	500	Exploratory fishing for pelagic and bottom fish, shrimp and crabs; gear research.
Murre II....	Juneau, Alaska...	86	1943	64,000	115	Oceanographic studies in coastal waters of Southeastern Alaska with limited use for servicing shore facilities.
John R. Manning.	do	86	1950	181,600	320	Bottom surveys for halibut; patrol work; observations on foreign fishing activities in Bering Sea.
Geo. M. Bowers.	Panama City, Fla.	73	1956	93,800	210	Primarily gear research.
Kaho...	Saugatuck, Mich.	65	1961	85,000	. .	Exploratory fishing and gear research on industrial fishes, chubs, alewives, sheepshead, gizzard shad, and smelt.
Rorqual	Gloucester, Mass.	64	1941	187,000	230	Gear research and inshore exploration on herring and shellfish.
T-19	South Carolina...	64	1942	187,000	.	On loan to State of South Carolina.
Cisco	Saugatuck, Mich.	60	1950	85,000	175	Research on deepwater fish species, their distribution, abundance, and ecology; limnology.
Heron.....	Juneau, Alaska...	58	1940	19,000	135	Salmon and herring research.
Musky II	Sandusky, Ohio..	53	1931	3,666	170	Studies on warm-water fishes of Lake Erie; limnology; pollution studies.
Siscowet	Ashland, Wis.....	52	1946	81,000	170	Research on deepwater fish species, their distribution, abundance, and ecology; limnology.
Shang Wheeler...	Milford, Conn....	50	1951	45,840	140	Shellfish research; oyster and clam propagation; predator control.
Alosa	Oxford, Md.....	48	1941	6,500	82	Shellfish research; oyster propagation and disease studies.
Kingfish.	St. Petersburg Beach, Fla.	43	1954	24,500	150	Estuarine investigations.
J-3486	North Carolina...	43	1942	28,000	. .	On loan to State of North Carolina.
Phalarope II.....	Boothbay Harbor, Maine.	40	1932	8,000	225	Clam and herring studies.
Sockeye	King Salmon, Alaska.	40	1946	11,250	175	Salmon research work.
J-1110	Beaufort, N.C....	40	1934	15,000	200	Research on shellfish, striped bass, and other coastal species; collection of samples for radiobiological studies.

Appendix G—Fish and Wildlife Service Publication Series and a 1964 List of Publications by Bureau Personnel

The regular, established series of the Fish and Wildlife Service in which Bureau of Commercial Fisheries publications appear are:

Fishery Bulletin.—Technical reports on scientific investigations of fishery biology. The Bulletin of the United States Fish Commission was begun in 1881; it became the Bulletin of the Bureau of Fisheries in 1904 and the Fishery Bulletin of the Fish and Wildlife Service in 1941. Separates were issued as documents through volume 46; the last document was No. 1103. Beginning with volume 47 in 1931 and continuing through volume 62 in 1963, each separate appeared as a numbered bulletin. A new system began in 1963 with volume 63 in which papers are bound together in a single issue of the bulletin instead of being issued individually. Volume 63, nos. 2 and 3, and volume 64 (902 p.) were issued in 1964. Some bulletins are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402; they are distributed free to libraries and to a limited number of scientific cooperators.

Fishery Industrial Research.—Technical reports dealing with scientific investigations of fishery technology, economics, exploratory fishing, and gear research. Volume 2, no. 3 (81 p.) was published in 1964. They are distributed free to libraries and to a limited number of scientific cooperators.

Special Scientific Report—Fisheries.—Preliminary or progress reports and reports on scientific investigations of restricted scope. Established as Special Scientific Reports in 1940, nos. 1 to 67 were issued from that date to 1949, when the new series, Special Scientific Report—Fisheries, with new serial numbering, was started. Twenty-five of these reports (1,301 p.) were published in 1964. They are distributed free to libraries and cooperators on a limited mailing list.

Fishery Leaflet.—Popular information on fishery subjects intended primarily for use in correspondence. Twelve leaflets (126 p.) were published in 1964. They are distributed free on request.

Circular.—Popular and semitechnical publications of general and regional interest intended to aid conservation and management. Fourteen circulars (488 p.) were published in 1964. They have free, but limited distribution.

Data Report.—Reports that include compilations of unanalyzed or partly analyzed data collected during biological, limnological, or oceanographic investigations. The reports are on 3- by 5-inch microfiche cards, each of which has up to 40 pages of material. The pages are reduced to one-eighteenth normal size; consequently, they can be read only through a microscope, microfiche "reader," or any similar device for enlarging. The Data Report series is the first microfiche series to be used for primary publication of scientific reports. Advantages of microfiche over regular size reports are threefold. They occupy only about one-hundredth as much space; they can be printed in a matter of weeks rather than months; and for our distribution lists, the cost of printing and mailing is only about one-tenth as much. Data Reports 1 through 7 (30 microfiche cards, 880 p.) were issued in 1964. They are distributed free to a restricted mailing list of laboratories, libraries, State fishery agencies, research institutions, and research scientists. [Full-size copy can be purchased.]

Fishery and Oceanography Translations.—Subject-indexed lists of translations that are available to fishery scientists and oceanographers; translations that are in progress; translated tables of contents of important foreign and oceanographic

journals; and abstracts of pertinent foreign scientific literature. Numbers 1, 2, and 3 (3 papers, 150 p.) were issued in 1964. Limited distribution is made to laboratories, libraries, State fishery agencies, research institutions, and research scientists.

Commercial Fisheries Abstracts.—A monthly abstract of world literature (chiefly English language) on fishery technology. Volume 17 in 1964 had 12 issues (336 p.). They have free, but limited distribution.

Commercial Fisheries Review.—A monthly periodical that features articles on Bureau research and operations and trends and developments in the domestic and foreign fisheries. Volume 26 in 1964 had 12 issues (1,436 p.). They are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Subscription price $6.50 a year; $2 additional for foreign mailing; single copies 60 cents each. Index for volume 23 (1961) of the Commercial Fisheries Review was issued also (66 p.).

Statistical Digest.—Annual statistics with detailed tabulations relating to fishery production, manufacture, and commerce. These succeeded the Administrative Report series. One digest (468 p.) was published in 1964. Digests are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402; some are distributed free to a limited mailing list.

Current Fishery Statistics.—Current statistical information on fishery production, manufacture, and domestic or foreign trade; issued monthly, quarterly, or annually, by States, regions or larger units. In 1964 there were 230 monthly landings reports (1,100 p.) for 19 States; 29 monthly reports of manufactured products (126 p.); and 44 annual reports of sectional and State operating units, catch statistics, manufactured products, and foreign trade (526 p.).

Fishery Products Report.—Daily (5 times a week), monthly and annual data on landings, receipts, supplies, prices, imports, movements of fish and fish products in local areas; market conditions; and fishery developments in the United States and foreign countries. Special Market News data reports also are issued sporadically. Seven Market News Service field offices prepare and mail these free reports. During 1964 the 1,764 daily reports totaled 6,159 pages; the 96 monthly and 8 annual reports, 1,697 pages; and the 7 supplementary reports, 90 pages.

Miscellaneous papers.—Fifteen miscellaneous papers, totaling 563 pages, were issued. Some were distributed to the fish processing industry, and others were distributed to the mass news media, food brokers and distributors, agricultural demonstration agents, and home economists.

A detailed list of publications of the Bureau of Commercial Fisheries and its personnel or contractors or collaborators during 1964 follows. The articles are listed by authors.

Publications [1]

Abegglen, C. E., D. G. Chapman, S. V. Dorofeev, S. G. Fedorov, Fukuzo Nagasaki, G. C. Pike, W. E. Ricker, V. B. Scheffer, and Ford Wilke.

North Pacific Fur Seal Commission report on investigations from 1958 to 1961. Presented to the North Pacific Fur Seal Commission by the Standing Scientific Committee on 26 November 1962. xi + 21 p.

Allen, Herbert E.

Chemical characteristics of south-central Lake Huron. *In* Proc. 7th Conf., p. 45–53. Univ. Mich., Inst. Sci. Technol., Great Lakes Res. Div., Publ. 11.

[1] This list does not include Commercial Fisheries Abstracts, Current Fishery Statistics, and Commercial Fisheries Review, except a few articles for which the authors' names are given.

Alverson, Dayton L.
Developing latent resources of the oceans. Fish. News Int. 3(2): 105, 107–108, 110, 112.

Alverson, Dayton L., Alonzo T. Pruter, and Lael L. Ronholt.
A study of demersal fishes and fisheries of the northeastern Pacific Ocean. H. R. MacMillan Lectures in Fish., Univ. British Columbia Press, Vancouver, B.C., 190 p.

Alverson, Dayton L., and Norman J. Wilimovsky.
Prospective developments in the harvesting of marine fishes. *In* Modern fishing gear of the world 2: 583–589. Fishing News (Books) Ltd., London.

Ambrose, Mary E., Charles F. Lee, and Frank T. Piskur.
Comparison of the picric acid turbidity and Nessler tests with subjective evaluations of quality of shrimp. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 53–56.

Ambrose, Mary E., and D. G. Snyder.
Pepsin digestibility: As an index of quality in fish meal: Part IB. Some studies in the USA. Fish. News Int. 3(3–4): 210, 212–213.

Anas, Raymond E.
Sockeye salmon scale studies. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 158–162.

Anderson, Margaret L., and Maynard A. Steinberg.
Effect of lipid content on protein–sodium linolenate interaction in fish muscle homogenates. J. Food Sci. 29(3): 327–330.

Anderson, William D., Jr.
Fishes of some South Carolina coastal plain streams. Quart. J. Fla. Acad. Sci. 27(1): 31–54.

New records of fishes for South Carolina, and the occurrence of *Chaetodipterus faber* in fresh water. Copeia 1964 (1): 243–244.

Note on "Conference on estuaries." BioScience 14(7): 51–52.

Austin, Thomas S.
Equalant II, a mid–summer "photograph" of the oceanographic conditions, tropical Atlantic Ocean. [Abstract.] Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 142–143.

Bailey, Merryll M.
Age, growth, maturity, and sex composition of the American smelt, *Osmerus mordax* (Mitchill), of western Lake Superior. Trans. Amer. Fish. Soc. 93(4): 382–395.

Bakkala, Richard.
Abernathy spawning channel proves effective for reproduction of chum salmon. Com. Fish. Rev. 26(12): 20–21.

Baptist, John P.
Retention of radionuclides by the Atlantic croaker, *Micropogon undulatus*. [Abstract.] Ass. Southeastern Biol., Bull. 11(2): 39.

Barkley, Richard A.
Studies of ocean currents near the Hawaiian Islands. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64: 25–26.

The theoretical effectiveness of towed–net samplers as related to sampler size and to swimming speed of organisms. J. Cons. 29(2): 146–157.

Barkley, Richard A., Bernard M. Ito, and Robert P. Brown.
Releases and recoveries of drift bottles and cards in the central Pacific. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 492, iii + 31 p.

Barrett, Izadore, and Frank J. Hester.
Body temperature of yellowfin and skipjack tunas in relation to sea surface temperature. Nature 203(4940): 96–97.

Barry, E. J.
Gulf fisheries (selected areas)–1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., New Orleans Market News Serv., 44 p.

List of primary receivers of imported fishery products and byproducts at Houston, Tex., 1964. U.S. Fish Wildl. Serv., Bur. Com. Fish., New Orleans Market News Serv., 3 p.

List of primary receivers of imported fishery products and byproducts, New Orleans, La., 1964. U.S. Fish Wildl. Serv., Bur. Com. Fish., New Orleans Market News Serv., 4 p.

List of primary receivers of imported fishery products at Miami, Fla., 1964. U.S. Fish Wildl. Serv., Bur. Com. Fish., New Orleans Market News Serv., 5 p.

Bauer, Richard D., Ancel M. Johnson, and Victor B. Scheffer.
Eye lens weight and age in the fur seal. J. Wildl. Manage. 28(2): 374–376.

Bauer, Richard D., Richard S. Peterson, and Victor B. Scheffer.
Age of northern fur seal at completion of its first molt. J. Mamm. 45(2): 299–300.

Beeton, Alfred M., and James W. Moffett.
Lake Michigan chemical data, 1954–55, 1960–61. U.S. Fish Wildl. Serv., Data Rep. 6, 3 microfiches (i + 102 p.).

Berry, Frederick H.
A hypomaxillary bone in *Harengula* (Pisces: Clupeidae). Pac. Sci. 18(4): 373–377.

Aspects of the development of the upper jaw bones in teleosts. Copeia 1964(2): 375–384.

Boolootian, Richard A., and Reuben Lasker.
Digestion of brown algae and the distribution of nutrients in the purple sea urchin *Strongylocentrotus purpuratus*. Comp. Biochem. Physiol. 11: 273–289.

Boss, Kenneth J.
A note on the synonymy of *Tellina subtrigona* Sowerby, 1866 (Mollusca: Bivalvia). The Veliger 6(4): 207–208.

New species of *Tellina* from the western Atlantic. Mus. Comp. Zool., Occas. Pap. Mollusks 2(29): 309–324.

Notes on a hybrid *Tellina* (Tellinidae). The Nautilus 78(1): 18–20.

The status of *Scrobicularia viridotincta* Carpenter (Mollusca: Bivalvia). The Veliger 6(4): 208–210.

Unionidae of Red Cedar River, Michigan. The Nautilus 77(4): 117–118.

Boss, Kenneth J., and Vida C. Kenk.
Anatomy and relationships of *Temnoconcha brasiliana* Dall. Mus. Comp. Zool., Occas. Pap. Mollusks 2(30): 325–344.

Bouchard, Loyal G.

Overall view of Soviet fisheries in 1963, with emphasis on activities off United States coasts. Com. Fish. Rev. 26(11a): 15–18.

Boyar, H. C.

Occurrence of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in shallow waters in the Gulf of Maine. Copeia 1964(1): 232–233.

Brooke, Richard O., Elinor M. Ravesi, Donald F. Gadbois, and Maynard A. Steinberg.

Preservation of fresh unfrozen fishery products by low–level radiation. III. The effects of radiation–pasteurization of amino acids and vitamins in clams. Food Technol. 18(7): 116–120.

Brooke, Richard O., and Maynard A. Steinberg.

Preservation of fresh unfrozen fishery products by low–level radiation. I. Introduction. Food Technol. 18(7): 112–113.

Brooker, J. R.

Sanitation maintenance in plants producing fishery products under inspection by the U.S. Department of the Interior. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 72–77.

Six years of frozen seafood inspection. Quick Frozen Foods 26(12): 111–114.

Weights and measures activities in the USDI fishery products standards and inspection programs. Com. Fish. Rev. 26(10): 8–11.

Buckley, J. L., and M. G. Hanavan.

U.S. Fish and Wildlife Service. BioScience 14(5): 32–33.

Bullis, Harvey R., Jr.

Muricidae (Gastropoda) from the northeast coast of South America, with descriptions of four new species. Tulane Stud. Zool. 11(4): 99–108.

Bureau of Commercial Fisheries.

A seafood tour of the U.S.A. Spec. Fish. Market. Bull., 12 p.

'Can–venient' ways with shrimp. Spec. Fish. Market. Bull., 12 p.

Commercial fisheries outlook, January–March 1964. U.S. Fish Wildl. Serv., Fish. Leafl. 336, 4 p.

Commercial fisheries outlook, April–June 1964. U.S. Fish Wildl. Serv., Fish. Leafl. 336, 4 p.

Commercial fisheries outlook, July–September 1964. U.S. Fish Wildl. Serv., Fish. Leafl. 336, 4 p.

50 bright 'n' breezy seafood ways for light 'n easy lunchroom days. 50 p.

Fish recipes from the Great Lakes. Spec. Fish. Market. Bull., 16 p.

Florida fish recipes. Spec. Fish. Market. Bull., 16 p.

Graduate educational grants in aquatic sciences for the academic year 1965–66. U.S. Fish Wildl. Serv., Fish. Leafl. 573, 4 p.

Heirloom seafood recipes to treasure. Spec. Fish. Market. Bull., FMB 64–1A, 20 p.

Operations of the Bureau of Commercial Fisheries under the Saltonstall–Kennedy Act, fiscal year 1963, v + 114 p.

Outdoor fish cookery. U.S. Fish Wildl. Serv., Circ. 189, 10 p.

Report of the Bureau of Commercial Fisheries for the calendar year 1962, iii + 98 p.

World's fair seafood fare, 8 p.

Bureau of Commercial Fisheries, Biological Laboratory, Beaufort, N.C.

Annual report of the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C., for the fiscal year ending June 30, 1962. U.S. Fish Wildl. Serv., Circ. 184, iii + 40 p.

Annual report of the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C., for the fiscal year ending June 30, 1963. U.S. Fish Wildl. Serv., Circ. 198, iii + 26 p.

Bureau of Commercial Fisheries, Biological Laboratory, Galveston, Tex.

Fishery research, Biological Laboratory, Galveston, Texas, fiscal year 1963. U.S. Fish Wildl. Serv., Circ. 183, iv + 106 p.

Bureau of Commercial Fisheries, Boston Market News Service.

New England fisheries monthly summary (1964). Twelve issues, January to December, total 290 p.

Bureau of Commercial Fisheries, Branch of Loans and Grants.

Fishing vessel construction differential subsidy. U.S. Fish. Wildl. Serv., Fish. Leafl. 574, ii + 11 p.

Bureau of Commercial Fisheries, Chicago Market News Service.

Monthly summary of Chicago's wholesale fishery products receipts, prices, and trends (1964). Twelve issues, January to December, total 194 p.

Bureau of Commercial Fisheries, Columbia Fisheries Program Office, Portland, Oreg.

Columbia River fishery program. U.S. Fish Wildl. Serv., Circ. 192, iii + 20 p.

Bureau of Commercial Fisheries, Division of Industrial Research.

Inspectors' instructions for grading frozen fried fish portions. November (first issue), 26 p.

Inspectors' instructions for grading frozen fried scallops. April (first issue), 27 p.

Inspectors' instructions for grading frozen raw breaded fish portions. July (second issue), 28 p.

Inspectors' instructions for grading frozen raw breaded fish sticks. December (first issue), 27 p.

Bureau of Commercial Fisheries, Hampton Market News Service.

Monthly summary of fishery products production in selected areas of Virginia, North Carolina, and Maryland (1964). Twelve issues, January to December, total 48 p.

Monthly summary of fishery products for Baltimore, Maryland (1964). Twelve issues, January to December, total 102 p.

Bureau of Commercial Fisheries, New Orleans Market News Service.

Gulf of Mexico monthly landings, production, and shipments of fishery products (1964). Twelve issues, January to December, total 145 p.

Bureau of Commercial Fisheries, New York Market News Service.

Information leaflet [on the New York "Fishery products reports"] (revised January 1964). 11 p.

List of primary receivers of imported fishery products and byproducts at New York, 1963, 23 p.

New York City's wholesale fishery trade monthly summaries (1964). Twelve issues, January to December, total 238 p.

Bureau of Commercial Fisheries, Region 2, St. Petersburg Beach, Fla.

Annual report, exploratory fishing and gear research, Bureau of Commercial Fisheries, Region 2, for fiscal year 1963 ending June 30, 1963. U.S. Fish Wildl. Serv., Circ. 193, iii + 68 p.

The commercial fisheries of the Gulf and South Atlantic region and their needs. U.S. Fish Wildl. Serv., Circ. 181, iv + 37 p.

Bureau of Commercial Fisheries, San Pedro Market News Service.

California fishery products and byproducts brokers, importers, and exporters, 1964, 8 p.

California fishery products monthly summary (1964). Twelve issues, January to December, total 192 p.

Bureau of Commercial Fisheries, Seattle Market News Service.

Washington and Alaska receipts and landings of fishery products for selected areas and fisheries (1964). Twelve issues, January to December, total 98 p.

Bureau of Commercial Fisheries, Technological Laboratory, Gloucester, Mass.

Annual report of the Bureau of Commercial Fisheries Technological Laboratory, Gloucester, Mass., for fiscal year ending June 30, 1962. U.S. Fish Wildl. Serv., Circ. 182, ii + 18 p.

To keep fish fresh. U.S. Fish Wildl. Serv., Circ. 190, 12 p.

Burner, Clifford J.

Pacific salmon. U.S. Fish Wildl. Serv., Fish. Leafl. 563, i + 11 p.

Butler, Charles.

A progress report on the development of international food standards. Com. Fish. Rev. 26(9): 1–9.

Butler, Philip A.

Commercial fishery investigations. *In* Pesticide–wildlife studies, 1963. A review of Fish and Wildlife Service investigations during the calendar year, p. 5–28. U.S. Fish Wildl. Serv., Circ. 199.

Carr, Ira A.

Lake Erie fisheries explorations, May–November 1960. Com. Fish. Rev. 26(4): 1–8.

Castagna, Michael.

Design and operation of a tray rack for the study of oysters. Com. Fish. Rev. 26(12): 21–22.

Chapman, D. G.

A critical study of Pribilof fur seal population estimates. U.S. Fish Wildl. Serv., Fish. Bull. 63: 657–669.

Chapoton, Robert B.

Surface trawl for catching juvenile American shad. Progr. Fish-Cult. 26(3): 143–144.

Chase, Joseph.

Oceanographic observations, 1961, east coast of the United States. U.S. Fish Wildl. Serv., Data Rep. 1, 6 microfiches (iv + 177 p.).

Childs, G. R., and G. F. Combs.

Use of chick plasma non–protein nitrogen in evaluating fish meals. Poultry Sci. 43(5): 1220–1222.

Cleaver, Fred C.

Origins of high seas sockeye salmon. U.S. Fish Wildl. Serv., Fish. Bull. 63: 445–476.

Coffin, Gareth W., and Walter R. Welch.
A technique for separating small mollusks from bottom sediments. Proc. Nat. Shellfish. Ass. 53: 175–180.

Cohen, Daniel M.
A review of the ophidioid fish genus *Luciobrotula* with the description of a new species from the western North Atlantic. Bull. Mar. Sci. Gulf Carib. 14(3): 387–398.

A review of the ophidioid fish genus *Oligopus* with the description of a new species from West Africa. Proc. U.S. Nat. Mus. 116(3494), 22 p.

Bioluminescence in the Gulf of Mexico anacanthine fish *Steindachneria argentea*. Copeia 1964(2): 406–409.

Lycenchelys bullisi, a new eelpout from the Gulf of Mexico. Proc. Biol. Soc. Wash. 77: 113–118.

Suborder Argentinoidea. *In* Fishes of the Northwest Atlantic, p. 1–70. Mem. Sears Found., Mar. Res. 1(4).

Collette, Bruce B., and Robert H. Gibbs, Jr.
Thunnus South, 1845 (Pisces): Proposed validation under the plenary powers. Z.N. (S.) 1652. Bull. Zool. Nomencl. 21(6): 442–443.

Colton, John B., Jr.
History of oceanography in the offshore waters of the Gulf of Maine. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 496, ii + 18 p.

Combs, G. F., E. H. Bossard, G. R. Childs, and D. L. Blamberg.
Effect of protein level and amino acid balance on voluntary energy consumption and carcass composition. [Abstract.] Poultry Sci. 43(5): 1309.

Connor, Anne R., Carl H. Elling, Edgar C. Black, Gerald B. Collins, Joseph R. Gauley, and Edward Trevor-Smith.
Changes in glycogen and lactate levels in migrating salmonid fishes ascending experimental "endless" fishways. J. Fish. Res. Bd. Can. 21(2): 225–290.

Connors, Thomas J., and Maynard A. Steinberg.
Preservation of fresh unfrozen fishery products by low-level radiation. II. Organoleptic studies on radiation-pasteurized soft-shell clam meats. Food Technol. 18(7): 113–116.

Cooper, R. A., S. B. Chenoweth, and N. Marshall.
Condition of the quahog, *Mercenaria mercenaria*, from polluted and unpolluted waters. Chesapeake Sci. 5(4): 155–160.

Cope, C. E.
Receipts and prices of fresh and frozen fishery products at Chicago, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., Chicago Market News Serv., 61 p.

Costello, T. J.
Field techniques for staining–recapture experiments with commercial shrimp. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 484, iii+ 13 p.

Coyne, James A.
Receipts of fresh and frozen fishery products at Baltimore's wholesale fish market, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., Baltimore Market News Serv., 58 p.

Cramer, Frederick K., and Ivan J. Donaldson.
Evolution of recovery nets used in tests on fish passage through hydraulic turbines. Progr. Fish-Cult. 26(1): 36–41.

Cramer, Frederick K., and Raymond C. Oligher.
Passing fish through hydraulic turbines. Trans. Amer. Fish. Soc. 93(3): 243–259.

Daugherty, Anita E., and Robert S. Wolf.
Age and length composition of the sardine catch off the Pacific coast of the United States and Mexico in 1961–1962. Calif. Fish Game 50(4): 241–252.

Davis, Harry C., and Anthony Calabrese.
Combined effects of temperature and salinity on development of eggs and growth of larvae of *M. mercenaria* and *C. virginica*. U.S. Fish Wildl. Serv., Fish. Bull. 63: 643–655.

Davis, William Spencer.
Graphic representation of confidence intervals for Petersen population estimates. Trans. Amer. Fish. Soc. 93(3): 227–232.

Dees, Lola T.
List of Fish and Wildlife Service papers on physical and chemical oceanography, 1940–62. U.S. Fish Wildl. Serv., Fish. Leafl. 561, 14 p.

DeLacy, Allan C., C. R. Hitz, and D. L. Dryfoos.
Maturation, gestation and birth of rockfish (*Sebastodes*) from Washington and adjacent waters. Wash. Dep. Fish., Fish Res. Pap. 2(3): 51–67.

Demory, Robert L., Russell F. Orrell, and Donald R. Heinle.
Spawning ground catalog of the Kvichak River system, Bristol Bay, Alaska. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 488, vii + 292 p.

Di Costanzo, Charles J., and Wilbur L. Hartman.
Productivity of sockeye salmon nursery lakes in western Alaska. [Abstract.] Science in Alaska. Proc. 14th Alaskan Sci. Conf.: 213.

Dodson, Anne N., and William H. Thomas.
Concentrating plankton in a gentle fashion. Limnol. Oceanogr. 9(3): 455–456.

Doherty, Richard M., G. Paul Draheim, Donald J. White, and Charles L. Vaughn.
Economic study of sea scallop production in the United States and Canada. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 57–79.

Dragovich, Alexander, and John A. Kelly, Jr.
Ecological observations of macro-invertebrates in Tampa Bay, Florida. Bull. Mar. Sci. Gulf Carib. 14(1): 74–102.

Dryer, William R.
Movements, growth, and rate of recapture of whitefish tagged in the Apostle Islands area of Lake Superior. U.S. Fish Wildl. Serv., Fish. Bull. 63: 611–634.

Dryer, William R., and Joseph Beil.
Life history of lake herring in Lake Superior. U.S. Fish Wildl. Serv., Fish. Bull. 63: 493–530.

Duke, Thomas W.
Observations on the movement of radionuclides in selected marine environments. Ecol. Soc. Amer., Bull. 43(4): 120.

Use of radioisotopes in marine biological research. Proc. 2d Annu. Oak Ridge Conf., p. 69–72. U.S. At. Energy Comm., TID–7689.

Edsall, Thomas A.
Feeding by three species of fishes on the eggs of spawning alewives. Copeia 1964(1): 226–227.

Ellis, Robert J.
The effect of confinement on blood lactate levels in chinook and coho salmon. Fish Comm. Oreg., Res. Briefs 10(1): 28–34.

Emerson, John A.
New fish holding, chilling methods offer advantages, BCF tests show. Fish Boat 9(10): 24–25, 48.

Emerson, J. A., N. Kazanas, R. A. Greig, and H. L. Seagran.
Irradiation preservation of fresh water fish. Prepared for U.S. At. Energy Comm., Div. Isotop. Develop., Isotop.–Ind. Technol. TID 4500 (19th ed.) Subcontract No. 1 under Prime Contract AT(11–1)–1283, 56 p. [Available from the Office of Technical Services, U.S. Department of Commerce, Washington, D.C., 20230; price $1.25.]

Emery, K. O., and A. S. Merrill.
Combination camera and bottom–grab. Oceanus 10(4): 2–7.

Engel, David W., and Edna M. Davis.
Relationship between activity and blood composition in certain marine teleosts. Copeia 1964(3): 586–587.

Engle, James B.
A brief history of Federal shellfish investigations in Chesapeake Bay. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 1–7. U.S. Fish Wildl. Serv., Circ. 200.

Shellfish advisory service—cooperation with the industry. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 79–83.

Eschmeyer, Paul H.
The lake trout (*Salvelinus namaycush*). U.S. Fish Wildl. Serv., Fish. Leafl. 555, 8 p.

Favorite, Felix.
Drift bottle experiment in the northern North Pacific Ocean, 1962–1964. J. Oceanogr. Soc. Jap. 20(4): 6–13.

Oceanography. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 141–148.

Favorite, Felix, Betty-Ann Morse, Alan H. Haselwood, and Robert A. Preston, Jr.
North Pacific oceanography, February–April 1962. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 477, iii + 66 p.

Feder, Howard M., and Reuben Lasker.
Partial purification of a substance from starfish tube feet which elicits escape responses in gastropod molluscs. Life Sci. 3(9): 1047–1051.

Finucane, John H.
Distribution and seasonal occurrence of *Gymnodinium breve* on the west coast of Florida, 1954–57. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 487, iv + 14 p.

Fiscus, Clifford H., Gary A. Baines, and Ford Wilke.
Pelagic fur seal investigations, Alaska waters, 1962. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 475, iii + 59 p.

Flittner, Glenn A.
Review of the movement of albacore tuna off the Pacific Coast in 1963. Com. Fish. Rev. 26(12): 13–19.

FORSTE, ROBERT H.
Future economic trends in the development of Pacific Northwest fisheries. Published for the Bonneville Power Administration and the U.S. Army Corps of Engineers, 143 p.

Industry trends and indicators of economic performance in the menhaden fishery. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 30–46.

FREDIN, R. A.
Ocean mortality and maturity schedules of Karluk River sockeye salmon and some comparisons of marine growth and mortality rates. U.S. Fish Wildl. Serv., Fish. Bull. 63: 551–574.

FRENCH, R.
Salmon distribution and abundance on the high seas—summer season—1963. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 121–131.

FRENCH, R., AND J. E. MASON.
Salmon distribution and abundance on the high seas—winter season—1962 and 1963. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 131–141.

FUSS, CHARLES M., JR.
Observations on burrowing behavior of the pink shrimp, *Penaeus duorarum* Burkenroad. Bull. Mar. Sci. Gulf Carib. 14(1): 62–73.

Shrimp behaviour as related to gear research and development. 1. Burrowing behaviour and responses to mechanical stimulus. *In* Modern fishing gear of the world 2: 563–566. Fishing News (Books) Ltd., London.

FUSS, C. M., JR., L. H. OGREN, AND D. W. KESSLER.
Shrimp behavior as related to gear research and development. [Abstract.] Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 51.

GALTSOFF, PAUL S.
The American oyster *Crassostrea virginica* Gmelin. U.S. Fish Wildl. Serv., Fish. Bull. 64: iii + 480 p.

GARRICK, J. A. F., AND STEWART SPRINGER.
Isistius plutodus, a new squaloid shark from the Gulf of Mexico. Copeia 1964 (4): 678–682.

GLUDE, JOHN B.
A survey of Japanese research on shellfisheries and seaweeds. U.S. Fish Wildl. Serv., Circ. 168, i + 20 p.

GOODING, REGINALD M.
Observations of fish from a floating observation raft at sea. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64:27.

GOULD, WILLIAM R., AND PHILIP A. BUTLER.
Estuarine pesticide studies. [Abstract.] Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 78–79.

GRAHAM, H. W.
United States research report, 1963. Int. Comm. Northwest Atl. Fish., Redbook, p. 113–129.

GREEN, ROGER E.
Norwegian bluefin tuna seines. Pac. Fisherman 62(1): 10–11.

GREENWOOD, M. R.
Vessel construction. Progress marked by improved designs . . . new ideas. Fish. Gaz. 81(13): 78–88.

Greig, R. A., H. L. Seagran, and J. A. Emerson.
How research in quality control can broaden lake herring markets. Fish Boat 9(13): 24–26, 50–51.

Groninger, Herman S., Jr.
Partial purification and some properties of a proteinase from albacore (*Germo alalunga*) muscle. Arch. Biochem. Biophys. 108(2): 175–182.

Groninger, Herman S., and John A. Dassow.
Observations of the "blueing" of king crab, *Paralithodes camtschatica*. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 47–52.

Gruger, E. H., Jr., R. W. Nelson, and M. E. Stansby.
Fatty acid composition of oils from 21 species of marine fish, freshwater fish and shellfish. J. Amer. Oil Chem. Soc. 41(10): 662–667.

Gutherz, Elmer J.
A range extension of the rare argentinoid fish, *Xenophthalmichthys danae* (Microstomidae). Copeia 1964 (1): 234.

New Atlantic coast ranges for fish. Quart. J. Fla. Acad. Sci. 27(4): 299–306.

Hall, Robert A., and Henry R. McAvoy.
New England fisheries—annual summary, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., Boston Market News Serv., 53 p.

Hanks, Robert W.
A benthic community in the Sheepscot River estuary, Maine. U.S. Fish Wildl. Serv., Fish. Bull. 63: 343–353.

Environmental features of the laboratory site; the Tred Avon River. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 18–23. U.S. Fish Wildl. Serv., Circ. 200.

Hardin, J. O., J. L. Milligan, and Virginia D. Sidwell.
The influence of solvent extracted fish meal and stabilized fish oil in broiler rations on performance and on the flavor of broiler meat. Poultry Sci. 43(4): 858–860.

Harry, George Y., Jr.
The shrimp fishery of Alaska. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 64–71.

Hartman, Wilbur L., Theodore R. Merrell, Jr., and Richard Painter.
Mass spawning behavior of sockeye salmon in Brooks River, Alaska. Copeia 1964 (2): 362–368.

Hartman, Wilbur L., and Robert F. Raleigh.
Tributary homing of sockeye salmon at Brooks and Karluk Lakes, Alaska. J. Fish. Res. Bd. Can. 21(3): 485–504.

Hartt, Allan C., and Michael B. Dell.
Tagging studies. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 113–121.

Heard, William R.
Phototactic behaviour of emerging sockeye salmon fry. Animal Behaviour 12(2–3): 382–388.

Helle, John H., Richard S. Williamson, and Jack E. Bailey.
Intertidal ecology and life history of pink salmon at Olsen Creek, Prince William Sound, Alaska. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 483, iii + 26 p.

Hennemuth, R. C., M. D. Grosslein, and F. D. McCracken.
Abundance, age composition of landings, and total mortality of haddock caught off southern Nova Scotia, 1956–1961. Int. Comm. Northwest Atl. Fish., Res. Bull. 1:43–73.

Henry, Kenneth A.
Aging fish from their scales. Sci. Teach. 31(4): 58–59.

Hester, Frank J.
Effects of food supply on fecundity in the female guppy, *Lebistes reticulatus* (Peters). J. Fish. Res. Bd. Can. 21(4): 757–764.

Heyamoto, H., and Miles S. Alton.
Sablefish. A major resource of the eastern Pacific? Pac. Fisherman 62(10): 25–27.

Hidu, Herbert, and Ravenna Ukeles.
Dried unicellular algae as food for larvae of the hard shell clam, *Mercenaria mercenaria*. Proc. Nat. Shellfish. Ass. 53: 85–101.

Higham, Joseph R., and William R. Nicholson.
Sexual maturation and spawning of Atlantic menhaden. U.S. Fish Wildl. Serv., Fish. Bull. 63: 255–271.

Hitz, Charles R.
Observations on egg cases of the big skate (*Raja binoculata* Girard) found in Oregon coastal waters. J. Fish. Res. Bd. Can. 21(4): 851–854.

Hodgins, Harold O., and George J. Ridgway.
Preservation of trout and salmon erythrocytes for blood typing by freezing with dimethyl sulphoxide. Nature 201(4926): 1336–1337.

Holliday, F. G. T., J. H. S. Blaxter, and Reuben Lasker.
Oxygen uptake of developing eggs and larvae of the herring (*Clupea harengus*). J. Mar. Biol. Ass. U.K. 44: 711–723.

Hoss, Donald E.
Accumulation of zinc–65 by flounder of the genus *Paralichthys*. Trans. Amer. Fish. Soc. 93(4): 364–368.

Howard, Gerald V.
Unmanned buoys and fishery oceanography, p. 49–57. Trans. Int. Buoy Technol. Symp., March 24–25, 1964. Mar. Technol. Soc., Washington, D.C.

Howell, John H., Everett L. King, Jr., Allen J. Smith, and Lee H. Hanson.
Synergism of 5, 2′–dichloro–4′ nitro salicylanilide and 3–trifluormethyl–4–nitrophenol in a selective lamprey larvicide. Great Lakes Fish. Comm., Tech. Rep. 8, 21 p.

Howell, John H., and Paul M. Thomas.
Anesthetic effect of 4–styrylpyridine on lamprey and fish. Trans. Amer. Fish. Soc. 93(2): 206–208.

Hunter, John R., and Warren J. Wisby.
Net avoidance behavior of carp and other species of fish. J. Fish. Res. Bd. Can. 21(3): 613–633.

Ingraham, W. James, Jr.
Distribution of physical–chemical properties and tabulations of station data, Washington and British Columbia coasts, May 1963. U.S. Fish Wildl. Serv., Data Rep. 5, 3 microfiches (i + 88 p.)

North Pacific oceanography February–March 1963. U.S. Fish Wildl. Serv., Data Rep. 3, 1 microfiche (i + 29 p.)

JARVIS, NORMAN D.
Caviar and other fish roe products. U.S. Fish Wildl. Serv., Fish. Leafl. 567, 9 p.

JENSEN, ALBERT C.
Wildlife ecology of a heavily–used aquatic area. N.Y. Fish Game J. 11(2): 132–147.

JEWETT, STANLEY G., JR.
A big fly for a big fish. The Creel 3(2): 30–31.

JOERIS, LEONARD S.
A horizontal sampler for collection of water samples near the bottom. Limnol. Oceanogr. 9(4): 595–598.

JOHNSEN, RICHARD C.
Direction of movement of salmon in the North Pacific Ocean and Bering Sea as indicated by surface gillnet catches, 1959–60. Int. N. Pac. Fish. Comm., Bull. 14: 33–48.

JOHNSON, JAMES H.
The Pacific coast tuna fleet. U.S. Nav. Inst. Proc. 90(6): 57–65.

JOYNER, TIMOTHY.
The determination and distribution of particulate aluminum and iron in the coastal waters of the Pacific Northwest. J. Mar. Res. 22(3): 259–268.

JUNE, FRED C., AND WILLIAM R. NICHOLSON.
Age and size composition of the menhaden catch along the Atlantic coast of the United States, 1958, with a brief review of the commercial fishery. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 446, iv + 40 p.

KARRICK, NEVA L., AND CLAUDE E. THURSTON.
Fish composition—proximate composition of silver salmon. J. Agr. Food Chem. 12(3): 282–284.

KARVELIS, ERNEST G.
The true pikes. U.S. Fish Wildl. Serv., Fish. Leafl. 569, 11 p.

KATO, SUSUMU.
Sharks of the genus *Carcharhinus* associated with the tuna fishery in the eastern tropical Pacific Ocean. U.S. Fish Wildl. Serv., Circ. 172, ii + 22 p.

KELLY, GEORGE F.
Some recent redfish (*Sebastodes*) publications ICES/ICNAF Redfish Symposium. Copeia 1964 (2): 460–464.

KELLY, WILLIAM N.
Production of fishery products in selected areas of Maryland, Virginia, and North Carolina, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., Hampton Market News Serv., 35 p.

KIFER, ROBERT R., AND EDGAR P. YOUNG.
Effect of fish oil on the organoleptic value of meat of swine. [Abstract.] J. Anim. Sci. 23(4): 1231.

KIFER, ROBERT R., EDGAR P. YOUNG, KAM C. LEONG, AND JOHN E. FOSTER.
Value of menhaden fish meal as a protein supplement to practical swine diets. III. Corn–meat and bone meal. [Abstract.] J. Anim. Sci. 23(3): 880–881.

KLIMA, EDWARD F.
Mark–recapture experiments with brown and white shrimp in the northern Gulf of Mexico. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 52–64.

KRAVANJA, MILAN A.
Soviet Far East fisheries expansion. Com. Fish. Rev. 26(11a): 1–14.

KRUSE, PAUL J., JR.
A remote controlled underwater photographic surveillance system. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 490, iii + 16 p.

KRUSE, THOMAS E.
A comparison of spaghetti and Petersen tags used on steelhead trout at Gnat Creek, Oregon. Fish Comm. Oreg., Res. Briefs 10(1): 57–66.

LA FAUNCE, DON A., J. B. KIMSEY, AND HAROLD K. CHADWICK.
The fishery at Sutherland Reservoir, San Diego County, California. Calif. Fish Game 50(4): 271–291.

LALANNE, JOHN.
Chum salmon morphological studies. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 154.

LANDER, ROBERT H., AND GEORGE K. TANONAKA.
Marine growth of western Alaskan sockeye salmon (*Oncorhynchus nerka* Walbaum). Int. N. Pac. Fish. Comm., Bull. 14: 1–31.

LANDRUM, BETTY J., AND THOMAS A. DARK.
Morphological classification of maturing sockeye salmon in 1962. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 154–158.

LANE, J. PERRY.
Time temperature tolerance of frozen seafoods. I. Review of some of the recent literature on the storage life of frozen fishery products. Food Technol. 18(7): 156–162.

LARKIN, P. A., R. F. RALEIGH, AND N. J. WILIMOVSKY.
Some alternative premises for constructing theoretical reproduction curves. J. Fish. Res. Bd. Can. 21(3): 477–484.

LARKINS, HERBERT A.
Comparison of salmon catches in monofilament and multifilament gillnets—Part II. Com. Fish. Rev. 26(10): 1–7.

Direction of movement of salmon in the North Pacific Ocean, Bering Sea and Gulf of Alaska as indicated by surface gillnet catches, 1961. Int. N. Pac. Fish. Comm., Bull. 14: 49–58.

Some epipelagic fishes of the North Pacific Ocean, Bering Sea, and Gulf of Alaska. Trans. Amer. Fish. Soc. 93(3): 286–290.

LARKINS, HERBERT A., AND ROBERT R. FRENCH.
Effect of direction of set and distance between nets on the salmon catch of two gillnets. Int. N. Pac. Fish. Comm., Bull. 14: 59–65.

LASKER, REUBEN.
An experimental study of the effect of temperature on the incubation time, development, and growth of Pacific sardine embryos and larvae. Copeia 1964 (2): 399–405.

Moulting frequency of a deep-sea crustacean, *Euphausia pacifica*. Nature 203(4940): 96.

LASSITER, ROY L., JR.
Utilization of U.S. otter-trawl shrimp vessels in the Gulf of Mexico, 1959–1961. Com. Fish. Rev. 26(2): 1–6.

LEE, CHARLES F., GEORGE M. KNOBL, JR., AND EMMETT F. DEADY.
Mechanizing the blue crab industry. Part III—Strengthening the industry's economic position. Com. Fish. Rev. 26(1): 1–7.

Lee, Charles F., and F. Bruce Sanford.
Crab industry of Chesapeake Bay and the South—an industry in transition. Com. Fish. Rev. 26(12): 1–12.

Lehman, L. W., and E. J. Gauglitz, Jr.
Synthesis of triglycerides from fish oil fatty acids. J. Amer. Oil Chem. Soc. 41(8): 533–535.

Leong, Kam C., George M. Knobl, Jr., Donald G. Snyder, and Edward H. Gruger, Jr.
Feeding of fish oil and ethyl ester fractions of fish oil to broilers. Poultry Sci. 43(5): 1235–1240.

Loosanoff, Victor L.
Variations in time and intensity of setting of the starfish, *Asterias forbesi,* in Long Island Sound during a twenty–five-year period. Biol. Bull. 126(3): 423–439.

Lowe, Jack I.
Chronic exposure of spot, *Leiostomus xanthurus,* to sublethal concentrations of toxaphene in seawater. Trans. Amer. Fish. Soc. 93(4): 396–399.

Lux, Fred E.
Landings, fishing effort, and apparent abundance in the yellowtail flounder fishery. Int. Comm. Northwest Atl. Fish., Res. Bull. 1: 5–21.

MacGregor, John S.
Relation between spawning–stock size and year–class size for the Pacific sardine *Sardinops caerulea* (Girard). U.S. Fish Wildl. Serv., Fish. Bull. 63: 477–491.

Macy, Paul T. (compiler).
Translations of fishery and oceanography literature, authors A–F. U.S. Fish Wildl. Serv., Fish. Oceanogr. Transl. 1: 8–37.

Translations of fishery and oceanography literature, authors G–KA. U.S. Fish Wildl. Serv., Fish. Oceanogr. Transl. 3, i + 35 p.

Magnuson, John J.
Activity patterns of scombrids. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64: 26.

Tuna behaviour research programme at Honolulu. *In* Modern fishing gear of the world 2: 560–562. Fishing News (Books) Ltd., London.

Malins, D. C., J. C. Wekell, and C. R. Houle.
Analysis of alcohols, hydroxy esters, glycerides, and glyceryl ethers as nitrates by thin layer chromatography and infrared spectrometry. Anal. Chem. 36(3): 658–661.

Reaction of acetyl nitrate with alcohol derivatives of fatty acids: A synthesis of nitrate esters. J. Amer. Oil Chem. Soc. 41(1): 44–46.

Marriott, Richard A. (compiler).
Stream catalog of the Wood River lake system, Bristol Bay, Alaska. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 494, ix + 210 p.

Marshall, J. S., A. M. Beeton, and D. C. Chandler.
Role of zooplankton in the freshwater strontium cycle and influence of dissolved salts. Verh. Int. Verein. Limnol. 15(2): 665–672.

Marvin, Kenneth T., and Raphael R. Proctor, Jr.
Preliminary results of the systematic screening of 4,306 compounds as "red–tide" toxicants. U.S. Fish Wildl. Serv., Data Rep. 2, 3 microfiches (i + 85 p.).

MATHISEN, OLE A., AND O. E. KERNS, JR.
Abundance, distribution, and size of juvenile red salmon of the 1960 year class in Iliamna Lake, Alaska. Science in Alaska 1963. Proc. 14th Alaskan Sci. Conf.: 191–202.

MAY, BILLIE Z.
Surface calcium–chlorinity relationships. Quart. J. Fla. Acad. Sci. 27(3): 177–185.

MCHUGH, J. L.
Research and the oyster industry. Proc. Nat. Shellfish. Ass. 53: 1–10.

MCKERNAN, DONALD L.
The fishing fleet and fisheries of Peru. U.S. Nav. Inst. Proc. 90(6): 116–117.

We must improve our fisheries. Fish. Gaz. 81(13): 18–22, 24–26, 126–128, 130.

MCNEELY, RICHARD L.
Development of the Cobb pelagic trawl—a progress report. *In* Modern fishing gear of the world 2: 240–247. Fishing News (Books) Ltd., London.

MCNEIL, WILLIAM J.
A method of measuring mortality of pink salmon eggs and larvae. U.S. Fish Wildl. Serv., Fish. Bull. 63: 575–588.

Redd superimposition and egg capacity of pink salmon spawning beds. J. Fish. Res. Bd. Can. 21(6): 1385–1396.

MCNEIL, WILLIAM J., AND WARREN H. AHNELL.
Success of pink salmon spawning relative to size of spawning bed materials. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 469, iii + 15 p.

MCNEIL, WILLIAM J., RALPH A. WELLS, AND DAVID C. BRICKELL.
Disappearance of dead pink salmon eggs and larvae from Sashin Creek, Baranof Island, Alaska. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 485, iii + 13 p.

MCNULTY, HAROLD M., JR.
Transportation. New trends in transportation. Fish. Gaz. 81(13): 106–109.

MEAD, GILES W., E. BERTELSEN, AND DANIEL M. COHEN.
Reproduction among deep-sea fishes. Deep-Sea Res. 11(4): 569–596.

MENARD, H. W., T. E. CHASE, AND S. M. SMITH.
Galapagos Rise in the southeastern Pacific. Deep-Sea Res. 11(2): 233–242.

MENARD, H. W., S. M. SMITH, AND T. E. CHASE.
Guyots in the Southwestern Pacific Basin. Geol. Soc. Amer., Bull. 75(2): 145–148.

MENZEL, DANIEL B., AND H. S. OLCOTT.
Myosin aggregation by fatty acids. [Abstract 2566.] Fed. Proc. 23(2): 529.

Positional distribution of fatty acids in fish and other animal lecithins. Biochim. Biophys. Acta 84(2): 133–139.

MERRELL, THEODORE R., JR.
Ecological studies of sockeye salmon and related limnological and climatological investigations, Brooks Lake, Alaska, 1957. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 456, iv + 66 p.

MERRILL, ARTHUR S.
Observations on adverse relations between the hydroid, *Hydractinia echinata*, and certain mollusks. Annual Reports for 1964 of the Amer. Malacol. Un., Bull. 31: 2.

Merrill, Arthur S., and Kenneth J. Boss.
Reactions of hosts to proboscis penetration by *Odostomia seminuda* (Pyramidellidae). The Nautilus 78(2): 42–45.

Merrill, Arthur S., and J. A. Posgay.
Estimating the natural mortality rate of the sea scallop (*Placopecten magellanicus*). Int. Comm. Northwest Atl. Fish., Res. Bull. 1: 88–106.

Merrill, Arthur S., and John R. Webster.
Progress in surf clam biological research. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 38–47. U.S. Fish Wildl. Serv., Circ. 200.

Miller, David, Kam C. Leong, George M. Knobl, Jr., and Edward Gruger, Jr.
Exudative diathesis and muscular dystrophy induced in the chick by esters of polyunsaturated fatty acids. Proc. Soc. Exp. Biol. Med. 116(4): 1147–1151.

Miller, George C.
An aberrant green sturgeon from the lower Columbia River. Fish Comm. Oreg., Res. Briefs 10(1): 70–72.

Miyauchi, D., M. Eklund, J. Spinelli, and N. Stoll.
Application of radiation–pasteurization processes to Pacific crab and flounder. Final summary for the period November 1962 to November 1963. vii + 152 p. U.S. At. Energy Comm. Rep. Number TID–19585, Isotop.–Ind. Technol. TID 4500 (19th ed.).

Irradiation preservation of Pacific coast shellfish. I. Storage life of king crab meats at 33° and 42° F. Food Technol. 18(6): 138–142.

Morse, Betty–Ann.
North Pacific and Bering Sea oceanography, 1960 and 1961. U.S. Fish Wildl. Serv., Data Rep. 7, 8 microfiches (i + 274 p.).

Mraz, Donald.
Age and growth of the round whitefish in Lake Michigan. Trans. Amer. Fish. Soc. 93(1): 46–52.

Age, growth, sex ratio, and maturity of the whitefish in central Green Bay and adjacent waters of Lake Michigan. U.S. Fish Wildl. Serv., Fish. Bull. 63: 619–634.

Nakamura, Eugene L.
A method of measuring visual acuity of scombrids. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet. 1963–64: 26–27.

Salt well water facilities at the Bureau of Commercial Fisheries Biological Laboratory, Honolulu. *In* John R. Clark and Roberta L. Clark (editors), Sea–water systems for experimental aquariums. A collection of papers, p. 169–172. U.S. Fish Wildl. Serv., Res. Rep. 63.

Needham, Paul R., and Richard Gard.
A new trout from central Mexico: *Salmo chrysogaster*, the Mexican golden trout. Copeia 1964 (1): 169–173.

Nelson, Richard W., and Harold J. Barnett.
Determining fish quality with a new electronic fish tester. Pac. Fisherman 62(12): 20–21.

Nelson, Richard W., and Claude E. Thurston.
Proximate composition, sodium, and potassium of Dungeness crab. J. Amer. Diet. Ass. 45(1): 41–43.

Neville, William C., and Gerald B. Talbot.
The fishery for scup with special reference to fluctuations in yield and their causes. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 459, iii + 61 p.

Nicholson, William R.
Growth compensation in four year classes of striped bass, *Roccus saxatilis*, from Albemarle Sound, North Carolina. Chesapeake Sci. 5(3): 145–149.

Nicholson, William R., and Joseph R. Higham, Jr.
Age and size composition of the menhaden catch along the Atlantic coast of the United States, 1959, with a brief review of the commercial fishery. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 478, iv + 34 p.

Age and size composition of the 1960 menhaden catch along the U.S. Atlantic coast with a brief review of the commercial fishery. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 479, iv + 41 p.

Patashnik, Max, and Herman S. Groninger, Jr.
Observations on the milky condition in some Pacific coast fishes. J. Fish. Res. Bd. Can. 21(2): 335–346.

Patashnik, Max, Charles F. Lee, Harry L. Seagran, and F. Bruce Sanford.
Preliminary report on experimental smoking of chub (*Leucichthys* sp.). Com. Fish. Rev. 26(11): 1–11.

Patten, Benjamin G.
Environmental requirement of the crested goby in Hood Canal, Washington. Underwater Natur. 2(2): 23–24.

Pearson, Roger E.
Pink salmon scale studies. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 162–165.

Use of a discriminant function to classify North American and Asian pink salmon, *Oncorhynchus gorbuscha* (Walbaum), collected in 1959. Int. N. Pac. Fish. Comm., Bull. 14: 67–90.

Pereyra, Walter T.
Mortality of Pacific oysters, *Crassostrea gigas* (Thunberg), in various exposure situations in Washington. Proc. Nat. Shellfish. Ass. 53: 51–63.

Fishery rarity—the remarkable flathead devilfish, *Opisthoteuthis californiana*. Fishermen's News 20(5): 1–8.

Peters, John A.
Time–temperature tolerance of frozen seafood. ASHRAE J. 6(8): 72–75, 91.

Peters, John A., Edward H. Cohen, and Enrico E. Aliberte.
Improving the quality of whiting. U.S. Fish Wildl. Serv., Circ. 175, i + 16 p.

Petersen, Richard S.
Northern fur seals from the Pribilofs. Zoonooz 37(9): 3–7.

Peterson, C. E.
Fishing vessel construction differential subsidies. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 46–50.

Potter, L. M.
Effects of fish meal, methionine and different cereal grains in turkey diets. Proc. Ass. South. Agr. Workers 61: 272–273.

Pottinger, S. R., and C. F. Winchester.
Increased use of fishmeal in South seen; layer, pet food use adds to consumption. Feedstuffs 36(4): 63–64.

Power, E. A.
Advance report on the fisheries of the United States, 1963. U.S. Fish Wildl. Serv., C.F.S. 3450, 23 p.

Fisheries. *In* Britannica Book of the Year: 366–367. Encyclopedia Britannica, Chicago.

Fisheries. *In* Encyclopedia Britannica: 362–366. Encyclopedia Britannica, Chicago.

Fisheries. *In* Encyclopedia International: 152–155. Grolier, Inc., New York.

Fisheries. *In* The Americana Annual, 1964: 240–241. Grolier, Inc., New York.

Fisheries of the United States, 1963 (a preliminary review). U.S. Fish Wildl. Serv., C.F.S. 3500, xiv + 64 p.

Statistical review of the fisheries. The catch. Fish. Gaz. 81(13): 118, 112–126.

Power, E. A., and C. H. Lyles.
Fishery statistics of the United States, 1962. U.S. Fish Wildl. Serv., Stat. Dig. 56, ii + 466 p.

Pruter, Alonzo T.
Demersal fishes and fisheries of the northeastern Pacific Ocean. Trans. 29th N. Amer. Wildl. Natur. Resourc. Conf.: 382–392.

Trawling results of the R/V *Anton Bruun* in the Bay of Bengal and Arabian Sea. Com. Fish. Rev. 26(11a): 27–34.

Quast, Jay C.
Meristic variation in the hexagrammid fishes. U.S. Fish Wildl. Serv., Fish. Bull. 63: 589–609.

Occurrence of the Pacific bonito in coastal Alaskan waters. Copeia 1964(2): 448.

Scuba census of fish populations. Science in Alaska. Proc. 14th Alaskan Sci. Conf.: 203–212.

Rathjen, Warren F., and Joaquim B. Rivers.
Gulf of Alaska scallop explorations—1963. Com. Fish. Rev. 26(3): 1–7.

Reardon, Charles M.
Halibut and troll salmon landings and ex-vessel prices for Seattle, Alaska ports and British Columbia, 1964–63. U.S. Fish Wildl. Serv., Bur. Com. Fish., Seattle Market News Serv., 36 p.

Seattle landings, receipts, and value of fishery products, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., Seattle Market News Serv., 38 p.

Reintjes, John W.
Annotated bibliography on biology of menhadens and menhadenlike fishes of the world. U.S. Fish Wildl. Serv., Fish. Bull. 63: 531–549.

The importance of the occurrence of menhaden in the coastal waters and estuaries of peninsular Florida. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 108–113.

Rice, Dale W.
The Hawaiian monk seal. Natur. Hist. 73(2): 48–55.

Rice, T. R.
Federal laboratories with special emphasis on the Bureau of Commercial Fisheries Radiobiological Laboratory. Ass. Southeastern Biol., Bull. 11(4): 79–86.

Richards, William Joseph.
Systematic studies of darters from southeastern United States (Pisces, Percidae). [Abstract.] Diss. Abstr. 24(9): 3899.

Richards, William J., and Leslie W. Knapp.
Percina lenticula, a new percid fish, with a redescription of the subgenus *Hadropterus*. Copeia 1964 (4): 690–701.

Ridgway, G. J., and F. M. Utter.
Salmon serology. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 149–154.

Rinckey, Gordon R., and Carl H. Saloman.
Effect of reduced water temperature on fishes of Tampa Bay, Florida. Quart. J. Fla. Acad. Sci. 27(1): 9–16.

Ripley, William Ellis.
The human side of technical assistance. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 146–151.

Risoli, T. J.
New York City's wholesale fishery trade, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., New York Market News Serv., 48 p.

Roden, Gunnar I.
Oceanographic aspects of Gulf of California. Marine Geology of the Gulf of California—a Symposium, Memoir 3:30–58.

Ronholt, Lael L.
Shrimp explorations off Vancouver Island (British Columbia) by M/V *John N. Cobb*, October–November 1962. Com. Fish. Rev. 26(6): 1–7.

Ronsivalli, Louis J., and John A. Peters.
Packaging. Packaging requirements for irradiated fishery products. Fish. Gaz. 81(13): 134, 136, 138.

Ropes, John W.
Tests of internal tags for green crabs (*Carcinus maenas*). Proc. Nat. Shellfish. Ass. 53: 147–159.

Roppel, Alton T., and Stuart P. Davey.
Evolution of fur seal management on the Pribilof Islands. [Abstract.] Science in Alaska. Proc. 14th Alaskan Sci. Conf.: 67–68.

Rosenfield, Aaron.
Studies of oyster microparasites. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 30–37. U.S. Fish Wildl. Serv., Circ. 200.

Rothschild, Brian J.
Observations on dolphins (*Coryphaena* spp.) in the central Pacific Ocean. Copeia 1964(2): 445–447.

Skipjack tuna oceanography. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64: 25.

Roubal, William T., and A. L. Tappel.
An automated sephadex column for the separation and molecular weight determination of proteins. Anal. Biochem. 9(2): 211–216.

Rounsefell, George A.
Preconstruction study of the fisheries of the estuarine areas traversed by the Mississippi River–Gulf Outlet Project. U.S. Fish Wildl. Serv., Fish. Bull. 63: 373–393.

ROYCE, WILLIAM F.
A morphometric study of yellowfin tuna *Thunnus albacares* (Bonnaterre). U.S. Fish Wildl. Serv., Fish. Bull. 63: 395–443.

RYAN, J. J., AND B. EVERS.
Precooked and prepared foods. *In* ASHRAE guide and data book, 1964 applications, ch. 48: 585–588. American Society of Heating, Refrigerating and Air–conditioning Engineers, Inc., New York.

SALOMAN, CARL H.
The shrimp *Trachypeneus similis* in Tampa Bay. Quart. J. Fla. Acad. Sci. 27(2): 160–164.

SALOMAN, CARL H., JOHN H. FINUCANE, AND JOHN A. KELLY, JR.
Hydrographic observations of Tampa Bay, Florida, and adjacent waters, August 1961 through December 1962. U.S. Fish Wildl. Serv., Data Rep. 4, 6 microfiches (ii + 114 p.).

SAMSON, V. J.
California fisheries, 1963. U.S. Fish Wildl. Serv., Bur. Com. Fish., San Pedro Market News Serv., 53 p.

SANFORD, F. BRUCE, KATHRYN L. OSTERHAUG, AND HELEN E. PLASTINO.
Author index of publications, addresses, and translations–1962, Bureau of Commercial Fisheries, Branches of Economics and Technology. U.S. Fish Wildl. Serv., Fish. Leafl. 560, 11 p.

SANFORD, F. BRUCE, AND HELEN E. PLASTINO.
Index of publications by the Branch of Technology, Bureau of Commercial Fisheries, 1955–59, inclusive. U.S. Fish Wildl. Serv., Fish. Leafl. 558, iv + 28 p.

SAUR, J. F. T., V. TONOLLI, AND J. VERDUIN.
Sources of limnological and oceanographic apparatus and supplies. Amer. Soc. Limnol. Oceanogr., Spec. Publ. 1, 32 p. [Limnol. Oceanogr. Suppl. to vol. 9.]

SCATTERGOOD, LESLIE W., AND LEWIS J. LOZIER.
Herring fishery of the U.S. Passamaquoddy Region. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 476, iii + 21 p.

SCHAEFERS, EDWARD A.
Highlights of the Second World Fishing Gear Congress. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 25–30.

SCHAEFERS, EDWARD A., AND DAYTON L. ALVERSON.
Second World Fishing Gear Congress. Com. Fish. Rev. 26(5): 1–11.

SCHAEFERS, EDWARD A., AND JOHN J. MURRAY.
How to improve radar detection. Fish Boat 9(7): 21–22, 24–25, 100–102.

SCHEFFER, VICTOR B.
Deep diving of elephant seals. The Murrelet 45(1): 9.

Estimating abundance of pelage fibres on fur seal skin. Proc. Zool. Soc. Lond. 143(1): 37–41.

Hair patterns in seals (Pinnipedia). J. Morph. 115(2): 291–303.

SCHEFFER, VICTOR B., AND BERTRAM S. KRAUS.
Dentition of the northern fur seal. U.S. Fish Wildl. Serv., Fish. Bull. 63: 293–342.

Schelske, Claire L., William D. C. Smith, and Jo-Ann Lewis.
Environmental radioactivity in molluscs. [Abstract.] Ass. Southeastern Biol., Bull. 11(2): 55.

Seckel, Gunter R.
Climatic oceanography and its application to the Hawaiian skipjack fishery. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64: 26.

Shapiro, Sidney.
Fisheries of the world. *In* Farmer's world, p. 161–177. Ybk. Agr., 1964. U.S. Dep. Agr., Washington, D.C.

Shaw, William N.
Natural and artificial pond culture of oysters. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 24–29. U.S. Fish Wildl. Serv., Circ. 200.

Seasonal gonadal changes in female soft-shell clams, *Mya arenaria*, in the Tred Avon River, Maryland. Proc. Nat. Shellfish. Ass. 53: 121–132.

Sherman, Kenneth.
Pontellid copepod occurrence in the central South Pacific. Limnol. Oceanogr. 9(4): 476–484.

Shippen, Herbert.
Bering Sea king crab investigations. Int. N. Pac. Fish. Comm., Annu. Rep. 1963: 165–167.

Shomura, Richard S.
Effectiveness of tilapia as live bait for skipjack tuna fishing. Trans. Amer. Fish. Soc. 93(3): 291–294

Shuster, C. Yvonne, J. R. Froines, and H. S. Olcott.
Phospholipids of tuna white muscle. J. Amer. Oil Chem. Soc. 41(1): 36–41.

Sindermann, Carl J.
The Bureau of Commercial Fisheries Biological Laboratory at Oxford: present and future. *In* The Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland: Programs and perspectives, p. 8–17. U.S. Fish Wildl. Serv., Circ. 200.

Sindermann, Carl J., and Kenneth A. Honey.
Serum hemagglutinins of the winter skate, *Raja ocellata* Mitchill, from the western North Atlantic Ocean. Copeia 1964(1): 139–144.

Skud, Bernard E.
Behavior of marine organisms during a solar eclipse. [Abstract.] Amer. Zool. 4(3): 130.

Slavin, Joseph W.
Freezing seafood—now and in the future. ASHRAE J. 6(5): 43–48.

Slavin, J. W., and C. Butler.
Fishery products. *In ASHRAE* guide and data book, 1964 applications, ch. 44: 529–542. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., New York, N.Y.

Slavin, Joseph W., and W. A. MacCallum.
Refrigeration. North American experience in chilling and freezing fish on board vessels. Fish. Gaz. 81(13): 96, 98–103.

Slavin, Joseph W., and P. Miller.
Irradiation nears reality. Food Eng. 36(1): 92, 94, 98.

Slavin, Joseph W., and Louis J. Ronsivalli.
Study of irradiated-pasteurized fishery products, October 1, 1962–September 30, 1963 (TID–19969), 79 p. Prepared for U.S. At. Energy Comm., Div. Isotop. Develop. under Contract No. AT(49–11)–1889. [Available from the Office of Technical Services, U.S. Department of Commerce, Washington, D.C., 20230; price $2.00.]

Slavin, Joseph W., Maynard A. Steinberg, and Louis J. Ronsivalli.
Radiation preservation of New England seafoods. Isotop. Radiat. Technol. 1(4): 317–324.

Smith, Howard Donald.
The segregation of red salmon in the escapements to the Kvichak River system, Alaska. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 470, iii + 20 p.

Smith, Keith A.
The use of air–bubble curtains as an aid to fishing. *In* Modern fishing gear of the world 2: 540–544. Fishing News (Books) Ltd., London.

Smith, Lloyd L., Jr., and Robert H. Kramer.
The spottail shiner in lower Red Lake, Minnesota. Trans. Amer. Fish. Soc. 93(1): 35–45.

Smith, Preston, Jr., Mary E. Ambrose, and George N. Knobl, Jr.
Improved rapid method for determining total lipids in fish meal. Com. Fish. Rev. 26(7): 1–5.

Smith, Stanford H.
Status of the deepwater cisco population of Lake Michigan. Trans. Amer. Fish. Soc. 93(2): 155–163.

The taxonomic status of *Leucichthys macropterus*, a cisco of Lake Erie. Copeia 1964 (1): 230.

Spandorf, A. H., and K. C. Leong.
The biological availability of calcium and phosphorus in menhaden fish meals. [Abstract]. Poultry Sci. 43(5): 1364–1365.

Sparks, Albert K., and Gilbert B. Pauley.
Studies of the normal postmortem changes in the oyster, *Crassostrea gigas* (Thunberg). J. Insect Path. 6(1): 78–101.

Spinelli, John.
Evaluation of the micro–diffusion method for the determination of tertiary volatile base in marine products. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 17–19.

Spinelli, J., M. Eklund, and D. Miyauchi.
Irradiation preservation of Pacific Coast shellfish. II. Relation of bacterial counts, trimethylamine and total volatile base to sensory evaluation of irradiated king crab meat. Food Technol. 18(6): 143–147.

Measurement of hypoxanthine in fish as a method of assessing freshness. J. Food Sci. 29(6): 710–714.

Sprague, Lucian M.
A new look at an old ocean. [Abstract.] Proc. Hawaiian Acad. Sci., 39th Annu. Meet., 1963–64: 25.

Stansby, Maurice E.
Fish: A prime 'health' food. Food Eng. 36(2): 47.

Stansby, Maurice E., and Gisela Jellinek.
Flavor and odor characteristics of fishery products with particular reference to early oxidative changes in menhaden oil. Food and Agriculture Organization of the United Nations, Symposium on the Significance of Fundamental Research in the Utilization of Fish, May 26–30, Sess. IV, Paper WP/IV/2, 13 p.

Stearns, Franklin.
Monthly sea–surface temperature anomaly graphs for Atlantic coast stations. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 491, i + 2 p.

Steinberg, Maynard A.
Radiation preservation studies at the Bureau of Commercial Fisheries Technological Laboratory, Gloucester, Mass. Fish. Gaz. 81(13): 139–141.

Stickney, Alden P.
Feeding and growth of juvenile soft–shell clams, *Mya arenaria*. U.S. Fish Wildl. Serv., Fish. Bull. 63: 635–642.

Salinity, temperature, and food requirements of soft–shell clam larvae in laboratory culture. Ecology 45(2): 283–291.

Storr, John F.
Ecology of the Gulf of Mexico commercial sponges and its relation to the fishery. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 466, iv + 73 p.

Stout, Virginia F., Darryl D. Des Marteau, and Edward H. Gruger, Jr.
Effects of ionizing radiation on lipids of fish. Final summary for the period November 1962 to November 1963. U.S. At. Energy Comm. Rep. Number TID–19586, Isotop. Ind. Technol. TID 4500 (19th ed.), 11 p.

Strasburg, Donald W.
A possible breakdown in symbiosis between fishes. Copeia 1964 (1): 228–229.

An aerating device for salt well water. *In* John R. Clark and Roberta L. Clark (editors), Sea–water systems for experimental aquariums. A collection of papers, p. 161–167. U.S. Fish Wildl. Serv., Res. Rep. 63.

Further notes on the identification and biology of echeneid fishes. Pac. Sci. 18(1): 51–57.

Postlarval scombroid fishes of the genera *Acanthocybium, Nealotus,* and *Diplospinus* from the central Pacific Ocean. Pac. Sci. 18(2): 174–185.

Sykes, James E.
Requirements of Gulf and South Atlantic estuarine research. Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 113–120.

Talbot, G. B.
Salt–water system at the U.S. Biological Laboratory, Beaufort, North Carolina. *In* John R. Clark and Roberta L. Clark (editors), Sea–water systems for experimental aquariums. A collection of papers, p. 119–123. U.S. Fish Wildl. Serv., Res. Rep. 63.

Tarrant, Robert M., Jr.
Rate of extinction of a conditioned response in juvenile sockeye salmon. Trans. Amer. Fish. Soc. 93(4): 399–401.

Terao, Patricia S.
Annual report of the Bureau of Commercial Fisheries Technological Laboratory, Seattle, Washington, calendar year 1962. U.S. Fish Wildl. Serv., Circ. 180, i + 14 p.

Thomas, William H.
An experimental evaluation of the C^{14} method for measuring phytoplankton production, using cultures of *Dunaliella primolecta* Butcher. U.S. Fish Wildl. Serv., Fish. Bull. 63: 273–292.

Thompson, Mary H.
Cholesterol content of various species of shellfish. 1.—Method of analysis and preliminary survey of variables. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 11–15.

Determination of sodium and potassium in fish and other marine products. J. Ass. Offic. Agr. Chem. 47(4): 701–707.

Thorsteinson, Fredrik V., and Theodore R. Merrell, Jr.
Salmon tagging experiments along the south shore of Unimak Island and the southwestern shore of the Alaska Peninsula. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 486, iii + 15 p.

Tretsven, Wayne I.
Bacteriological survey of filleting processes in the Pacific Northwest. III. Bacterial and physical effects of pughing fish incorrectly. J. Milk Food Technol. 27(1): 13–17.

Ulmer, David H. B., Jr.
Preparation of chilled meat from Atlantic blue crab. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 21–45.

U.S. Fish and Wildlife Service.
Federal Specification, clams, canned. PP–C–400a, June 15, 9 p. Superseding Int. Fed. Spec. PP–C–00400 (INT–FWS), July 10, 1962. [Copies available from General Services Administration, Washington, D.C., 20405.]

Federal Specification, sponge, natural. C–S–631e, October 2, 6 p. Superseding Int. Fed. Spec. C–S–00631d (INT–F&WS), May 8, 1961 and Fed. Spec. C–S–631b, June 24, 1941. [Copies available from General Services Administration, Washington, D.C., 20405.]

Interim Federal Specification, salmon, canned. PP–S–0031d (INT–FWS), November 3, 8 p. Interim Revision of Fed. Spec. PP–S–31c, February 3, 1954. [Copies available from General Services Administration, Washington, D.C., 20405.]

United States standards for grades of frozen fish blocks. Fed. Reg. 29 (176): 12730–12731.

Utter, Fred M., George J. Ridgway, and Harold O. Hodgins.
Use of plant extracts in serological studies of fish. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 472, iii + 18 p.

Vrooman, Andrew M.
Serologically differentiated subpopulations of the Pacific sardine, *Sardinops caerulea*. J. Fish. Res. Bd. Can. 21(4): 691–701.

Waldron, Kenneth D.
Fish schools and bird flocks in the Central Pacific Ocean, 1950–1961. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 464, iv + 20 p.

Waters, Melvin E.
Comparison of chemical and sensory tests for assessing storage life of iced calico scallops (*Pecten gibbus*). U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(3): 5–10.

WATHNE, FREDERICK.
Shrimp behaviour as related to gear research and development. 2. Shrimp reaction to electrical stimulus. *In* Modern fishing gear of the world 2: 566–569. Fishing News (Books) Ltd., London.

WATHNE, FRED, AND JOHN K. HOLT.
How the electrical shrimp trawl was developed and what the tests show. Fish Boat 9(3): 56–58.

WATSON, JOHN E.
A tag for young herring. Underwater Natur. 2(2): 6–8.

Determining the age of young herring from their otoliths. Trans. Amer. Fish. Soc. 93(1): 11–20.

WEKELL, JOHN C., CLIFFORD R. HOULE, AND DONALD C. MALINS.
A method for the isolation of mono– and di–hydric alcohols from complex mixtures. J. Chromatogr. 14(3): 529–531.

WHITE, JOHN C., JR.
Fractionated doses of X–radiation: A preliminary study of effects on teleost embryos. Int. J. Radiat. Biol. 8(1): 85–91.

WHITE, JOHN C., JR., AND DONALD E. HOSS.
Another record of incomplete ambicoloration in the summer flounder, *Paralichthys dentatus*. Chesapeake Sci. 5(3): 151–152.

WIBORG, KRISTIAN FR.
Current Soviet articles on fisheries and oceanography. U.S. Fish Wildl. Serv., Fish. Oceanogr. Transl. 2, i + 77 p.

WIBORG, KRISTIAN FR., AND PAUL T. MACY.
Russian serials of interest to aquatic biologists, fishery technologists, and oceanographers. U.S. Fish Wildl. Serv., Fish. Oceanogr. Transl. 1: 1–7.

WIGLEY, ROLAND L.
Part I. Order Mysidacea; part 2. order Cumacea. *In* Ralph I. Smith (editor), Keys to marine invertebrates of the Woods Hole region, p. 93–102. Mar. Biol. Lab., Syst.–Ecol. Program, Contrib. 11.

WIGLEY, ROLAND L., AND A. D. MCINTYRE.
Some quantitative comparisons of offshore meiobenthos and macrobenthos south of Martha's Vineyard. Limnol. Oceanogr. 9(4): 485–493.

WILLIAMS, RICHARD B.
Phytoplankton productivity at Beaufort, North Carolina. [Abstract.] Ass. Southeastern Biol., Bull. 11(2): 59.

WILLIS, RAYMOND A.
Experiments with repeated spawning ground counts of coho salmon in three Oregon streams. Fish Comm. Oreg., Res. Briefs 10(1): 41–45.

WINCHESTER, CLARENCE F.
Industrial products. Price recovery registered in industrial fisheries products market. Fish. Gaz. 81(13): 112, 114–115. 183.

Symposium on growth: Environment and growth. J. Anim. Sci. 23(1): 254–264.

WOLF, ROBERT S.
Observations on spawning Pacific sardines. Calif. Fish Game 50(1): 53–57.

WOOD, LEONARD E.
Bottom sediments of Saginaw Bay, Michigan. J. Sediment. Petrol. 34(1): 173–184.

Wyrti, Klaus.
The thermal structure of the eastern Pacific Ocean. Erganzungsheft Deut. Hydrograph. Z., Herausgegeben Deut. Hydrograph. Inst., Reihe A (8°) 6: 1–84.

Total integrated mass transports and actual circulation in the eastern South Pacific Ocean. *In* Studies on oceanography: A collection of papers dedicated to Koji Hidaka and edited by Kozo Yoshida, p. 47–52. University of Tokyo Press, Tokyo.

Upwelling in the Costa Rica Dome. U.S. Fish Wildl. Serv., Fish. Bull. 63: 355–372.

Yancey, Robert M.
The biology of Alaska commercial shrimp. [Abstract.] Science in Alaska. Proc. 14th Alaskan Sci. Conf.: 214.

Zein-Eldin, Z. P., and D. V. Aldrich.
Laboratory studies of shrimp tolerances to salinity and temperature. [Abstract.] Proc. Gulf Carib. Fish. Inst., 16th Annu. Sess.: 121.

Zimmer, Paul D., and John H. Broughton.
Annual fish passage report—Rock Island Dam, Columbia River, Washington, 1962. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 467, iii + 26 p.

Appendix H—Operations of the Bureau of Commercial Fisheries under the Saltonstall-Kennedy Act, calendar year 1964

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This is the 10th annual report to the Congress, as required by law, of the operations of the Bureau of Commercial Fisheries under the provisions of the Saltonstall–Kennedy Act of July 1, 1954 (68 Stat. 376; 15 U.S.C., Sec. 713c–3).

The Saltonstall–Kennedy Act authorized the transfer of funds (30 percent of the annual customs duties collected on imported fishery products) from the Department of Agriculture to the Department of the Interior to promote fishery marketing and research beneficial to the domestic fishing industry. The Act also authorized the Secretary of the Interior to appoint an industry advisory committee to advise him on general fishery matters.

The American Fisheries Advisory Committee was established in 1955 and is comprised of key fishing industry representatives who are appointed by the Secretary of the Interior to advise him on general fishery matters. Meetings of the Committee are called at least once each year by the Assistant Secretary for Fish and Wildlife, who is the Committee's permanent Chairman. The 17th meeting of the Committee was held in Honolulu on January 22 to 25, 1964, and the 18th meeting in Gloucester, Mass., on October 5 to 7, 1964.

A list of the Committee members in 1964 follows.

Ralph E. Carr, President
Mid–Central Fish Co.,
1656 Washington Street,
Kansas City, Mo. 64108

Chris Dahl
Kayler–Dahl Fish Co.,
Box 1092,
Petersburg, Alaska 99833

George J. Davidson
Boat Service Corp.,
Room #1, Administration Building,
Fish Pier,
Boston, Mass. 02100

J. Roy Duggan, President
King Shrimp Co., Inc.,
Post Office Box 899,
Brunswick, Ga. 31421

Ammon G. Dunton
Dunton, McLeod & Simmons,
White Stone, Va. 32578

Milton F. Fillius
Westgate-California Corp.,
1995 Bay Front,
San Diego, Calif. 92113

Louis Fischer
Fischer Sea Foods,
Cocoa, Fla. 32923

Ray H. Full, President
Kishman Fish Co.,
Vermilion, Ohio 44089

H. R. Humphreys, Jr., President
Standard Products Co., Inc.,
Kilmarnock, Va. 22482

Leon S. Kenney, President
Pinellas Seafood Co.,
1533 Third Street, South,
St. Petersburg, Fla. 33701

E. Robert Kinney, President
Gorton's of Gloucester, Inc.,
327 Main Street,
Gloucester, Mass. 01931

Thomas D. McGinnes, President
Virginia Seafoods, Inc.,
Irvington, Va. 22480

John S. McGowan, President
Bumble Bee Seafoods, Inc.,
Astoria, Oreg. 97103

James McPhillips, Vice Chairman
Southern Industries Corp.,
Post Office Box 1685,
Mobile, Ala. 36601

John Mehos
Liberty Corporations,
Post Office Box 267,
7th & Wharf,
Galveston, Tex. 77550

Arthur H. Mendonca, President
F. E. Booth Co., Inc.,
3150 Third Street,
San Francisco, Calif. 94124

Anthony Nizetich, Director of
Government and Industry Relations,
Star Kist Foods, Inc.,
Terminal Island, Calif. 93465

Einar Pedersen
8801 Golden Gardens Drive, N.W.,
Seattle, Wash. 98100

Roy Prewitt
American Fish Farmers Federation,
Post Office Box 191,
Lonoke, Ark. 72086

Daniel H. Smith
Smith Brothers of Port Washington,
100 North Franklin Street,
Port Washington, Wis. 53074

Chairman: Frank P. Briggs, Assistant Secretary for Fish and Wildlife
Executive Secretary: Robert D. Balkovic, Bureau of Commercial Fisheries

The following S–K funds have been available to the Bureau of Commercial Fisheries since 1955:

Fiscal year	*Amount of funds*
1955	$4,207,826
1956	4,321,403
1957	4,359,115
1958	4,651,151
1959	4,786,415
1960	4,993,642
1961	5,321,081
1962	4,757,143
1963	5,071,342
1964	5,373,096
10–year average	4,784,221

The Bureau uses S–K funds to carry out programs of research and services to assist the fishing industry in stabilizing and increasing its supply of raw materials, develop new and improved harvesting methods, improve product quality, find new uses for marine products, and improve the marketing structure of the fisheries. The programs of research and services presented in this report are coordinated and integrated with related programs financed by annually appropriated funds to bring the best personnel and facilities to bear on diverse fishery problems. Marketing and home economics activities are financed entirely with S–K funds.

Each geographic region of the Nation has distinctive fishery resources, the management of which requires specialized Bureau programs. For this reason, the Bureau of Commercial Fisheries is organized on a regional basis, and it is appropriate to present a summary of progress on S–K programs in this fashion.

Alaska

A great deal of study was made on bottomfish and salmon problems in Alaska. Studies were made on juvenile chum and pink salmon, pink salmon in estuaries of Southeastern Alaska and at Little Port Walter, pink salmon spawning grounds in Prince William Sound after the earthquake, effects of logging on productivity of pink salmon streams in Southeastern Alaska, salmon ecology in small lake systems of Southeastern Alaska, sockeye salmon in the Kvichak River watershed and in the Nushagak system, and sockeye salmon growth and survival studies. Other activities included technical advisory services to the seafood industry. Details of these activities follow.

Bottomfish Study

Goals of the bottomfish studies are grouped under four categories: (1) To determine the extent and density of commercially important fish stocks in the Gulf of Alaska and Bering Sea, (2) to establish estimates of these populations to refer to when the stocks are more heavily used by the fisheries, (3) to measure the changes in stocks associated with increased fishing pressure so that the fisheries may be intelligently managed, and (4) to determine the environmental factors underlying geographic variation in fishery production and total potential for production.

Computer systems are being designed for storing and analyzing data on fish populations, production statistics, and the fish ecology of the Gulf of Alaska and Bering Sea. Data inputs for this system include published material on the fisheries and fish populations, unpublished data sources, such as length–frequency distribution of commercial fishes obtained by Bureau laboratory personnel who had tours of duty aboard Japanese trawlers in the Gulf of Alaska, catch statistics furnished by the Japanese Fishery Agency, data from the National Oceanographic Data Center, and other miscellaneous reports on the fisheries or fishery ecology of the regions. Development of these systems has required fundamental research in several areas. Of most immediate importance is the development of the mathematical technique for characterizing fish populations by computer analysis. Techniques are being developed also for the mathematical characterization of ecological factors, such as depth of thermocline, current structure, turbulence, and bottom relief. The principal components of the storage and analysis system for analyzing population factors and storing data have had trial runs with data on yellowfin sole and cod. Results indicate that the systems are workable.

Salmon

The Bureau made studies on the commercially important chum, pink, and sockeye salmon.

Chum and Pink

Chum and pink salmon studies.—Bureau biologists studied juvenile chum and pink salmon from April through June as the fish migrated through the inner bay of Traitors Cove. The outmigration of chum and pink salmon fry from Traitors River was sampled by fishing two fry migrant traps below the major spawning areas. Juvenile salmon migrating through the inner bay were sampled with two floating fry traps, one on each side of the bay. Surveys were made in April and June in the inner and outer bays to determine the distribution of juvenile pink and chum salmon.

Pink salmon estuary program.—Plans were completed for beginning a full-scale pink salmon estuary program in the spring of 1964 in Southeastern Alaska. The 57-foot M/V *Heron* was modified to make it suitable as a mobile research base. A 20-foot high-speed reconnaissance vessel, *Blueboat,* is being used with the *Heron* to establish the distribution and behavior of major stocks of juvenile pink salmon in Southeastern Alaska between the time they leave the streams and the time they enter the open ocean. Hydrographic instruments are being used on both vessels. The two vessels made six summer cruises, requiring 52 days and covering 4,000 miles.

Pink salmon investigation at Little Port Walter.—Total fresh-water survival (from potential egg deposition to fry migration) of 1963 brood year salmon in Sashin Creek was 19.6 percent for pink salmon and 4.7 percent for chum salmon. Fresh-water survival of pink salmon (20 brood years) has averaged 7 percent (range 0.2 to 23 percent) and of chum salmon (21 brood years) 4 percent (range 0 to 14 percent). Survival of 1963 brood year pink salmon was among the highest observed, whereas that of 1963 brood year chum salmon was near average. Survival varied among the portions of the spawning ground sampled, being highest in the upstream steep gradient portion. Lowest survival occurred in the portion where spawners were most dense and gradient was lowest.

A graduate student continued laboratory and field studies of fine particle movement in spawning beds. A streambed model performed very well at the Bureau's Biological Laboratory at Auke Bay, and demonstrated the manner in which bed profile and hydraulic characteristics of the stream influence the movement of fine particles. A new field method of accurately measuring hydraulic gradient over short distances uses standpipes and a manometer and is easily portable.

Pink salmon spawning grounds in Prince William Sound.—Changes in stream elevations resulting from the March 27, 1964, Alaska earthquake produced drastic alterations in the physical environment of Prince William Sound pink salmon spawning grounds. In 1964 the Bureau's Biological Laboratory at Auke Bay completed a study of the initial effects of the earthquake on spawning streams in the Sound.

The changes in land elevation and subsequent secondary effects directly and adversely affected the most important spawning areas of Prince William Sound—the intertidal streambeds. An average of 46 percent of the Prince William Sound pink salmon run spawns in the intertidal stream channel in odd-numbered years and an average of 74 percent in even-numbered years. Elevations of 226 streams used by about 75 percent of the total pink salmon population have been changed; therefore, the earthquake, or its secondary effects, may have altered the spawning habitats of about 37 percent of the odd-year pink salmon runs and 56 percent of the even-year ones.

Intertidal studies under way since 1960 at the Bureau's Research Station at Olsen Bay, which is located in an area that was uplifted 5 feet, provide a basis for evaluating changes in production caused by the earthquake. To augment studies on the effects of the earthquake at Olsen Creek, additional studies were made at the end of the spawning season in sections of present and former intertidal streambeds of three additional streams.

The distribution of pink salmon spawning in intertidal areas in 1964 was similar to that of previous years at the same tide levels. Despite uplift or subsidence of stream areas, pink salmon behavior was normal in regard to intertidal use. Spawners did not "home" to former intertidal areas of uplifted streams—now fresh-water areas—which previous generations had used for spawning. The returning adults, instead, chose the newly formed intertidal zone.

Subsidence has drowned former intertidal areas of some streams, and, as a result, spawners have moved upstream to productive tide levels. Subsidence has the net effect of shortening streams and removing the lower stream areas from production.

Streams in uplifted areas have not yet reached equilibrium. They are degrading or cutting down the bottom and moving laterally as they seek sea level. During floods, dissection of uplifted beach surfaces forms new channels. In the three uplifted streams studied lateral shifting or new channel formation or both is occurring. The number of eggs lost from formation of new channels is unknown.

It is evident that the runs returning from the 1964 and perhaps the 1965 brood years will not be as large as they would have been had the earthquake not occurred. Because a major portion of Prince William

Sound streams is located in uplifted areas, mortalities of eggs and fry are certain to be higher than average until the degrading process is complete and streams have stabilized, and until stream action and spawning activity of spawning salmon remove fine materials from newly exposed spawning beds.

Pink salmon streams in Alaska.—The Northern Forest Experiment Station of the U.S. Forest Service began studies to evaluate the effects of logging on the productivity of salmon streams at Hollis, in Southeastern Alaska, in 1949, and in 1956, FRI (Fishery Research Institute), under contract to the Bureau, began a study of the biological aspects of the effects of logging. Prior to the beginning of the FRI study little was understood of how the environment influences the growth and development of salmon eggs and larvae and causes their mortality. There was still less understanding of the interrelation among spawning behavior, physical and biological attributes of the stream and spawning bed, and mortality of salmon eggs and larvae. Research at Hollis has provided substantial answers to these questions. The major causes of mortality have been found to be superimposition of eggs, freezing, inadequate supplies of good quality intragravel water, and erosion caused by floods. Changes in the environment of the stream caused by logging have been found to be mainly the result of adding logging debris or increased sedimentation. FRI has modified its original program to include alterations caused by logging to stream bank vegetation and stream ecology.

The Bureau's laboratory at Auke Bay, the Alaska Department of Fish and Game, and the Alaska Salmon Industry cooperatively evaluated the transplantation of adult pink salmon. Fish were transplanted from Bear Harbor on Kuiu Island to Sashin Creek on Baranof Island in late August. The even–year run of pink salmon to Sashin Creek has been depressed since 1950—in 1962, only eight pink salmon entered Sashin Creek to spawn. The virtual absence of a natural run of pink salmon in the even year provides an opportunity to study the spawning behavior of transplanted adults and survival of their progeny. The fish released in Sashin Creek above the weir did not try to move downstream. Spawning occurred in September, mostly in the lower two–thirds' area of spawning ground. No dead unspawned females were seen; bears killed a few unspawned males. The average number of eggs retained by spawned–out females was only 11.

Sockeye

Auke Lake study.—The study of salmon ecology in small lake systems of Southeastern Alaska continued with the collection of pertinent limnological data from the Auke Lake system and the completion of a

geological history of the Auke Lake basin. The ice cover on Auke Lake never exceeded 12 inches throughout the winter. Freezing conditions relaxed in severity after the November period of low temperatures and low flows. Estimates of the number of fry in the spring showed that the survival rate was low, which was expected after the hard freeze in November before the snow cover was adequate for insulation. A complete estimate of the sockeye smolt outmigration was made for the first time in the spring. By the end of August the run of over 5,400 sockeyes had a potential deposition of 8.5 million eggs. Studies of both adults and juveniles again show that the Auke Lake sockeyes spent 2 years in the Lake before migrating to the ocean. In 1964 most of the females had spent 3 years at sea, while almost half of the males had spent only 2 years there. Data on age, growth, and food habits of juvenile sockeye in the Lake were collected every 3 weeks.

Kvichak system studies.—FRI has studied sockeye salmon in the Kvichak River watershed since 1947. Certain specific studies were carried out in the 1964 field season. Carbon 14 and phytoplankton pigment estimates of primary productivity were made at three stations in Iliamna Lake (Kvichak system) during June, July, August, and September, 1964. The stations were near the Lake outlet, in midlake near Iliamna village, and in the upper lake in Knutson Bay. In addition, scientists measured pH, alkalinity, dissolved oxygen, temperature profile, and Secchi disk light transmission. Water samples were taken from 24 stations in Iliamna Lake each month from June through September for analysis of soluble and total phosphorus. Phosphorous samples were drawn from the Newhalen, Kvichak, Copper, and Iliamna Rivers. Samples of sockeye smolts and prespawning and postspawning adults were collected for analyzing content of total phosphorus and trace elements. Four vertical 20–inch net samples of zooplankton were collected from 131 feet depth to surface at each of 42 stations in Iliamna Lake in June, July, August, and September to assess zooplankton distribution. Along with the zooplankton sampling, biologists made 174 bathythermograph casts to assess the summer heat budget, pattern of summer heating, and thermostratification of Iliamna Lake.

As in past years, distribution of spawners was determined by aerial surveys at about 2–week intervals from August 5 through late September. All areas were surveyed at least once at or near the peak spawning period, and major areas were surveyed more than once.

Samples of spawning fish for age determination were obtained from 13 key spawning areas in the Kvichak system. Effort was made to obtain 100 lengths as well as otoliths and 40 scale samples from both sexes from each area.

A census was made to evaluate the personal-use catch of sockeye salmon in the villages within the Kvichak system.

Nushagak system studies.—The present study is a continuation of an FRI research program on Nushagak system sockeye salmon begun in 1946 and first supported by the Bureau in 1959. Emphasis of research has been to determine what factors control sockeye salmon population levels in the lakes of the Nushagak District. Biologists sampled adult sockeye salmon on the spawning grounds to ascertain differences in age composition and racial makeup among spawning colonies. Length measurements, scales, and otoliths were taken from 5,295 spawned-out sockeye salmon in selected spawning areas in the Wood River and Tikchik lakes. Areas were selected on the basis of spawning area type, importance, and continuity of available past records.

Two experiments were run to compare length measurements of live and dead adult sockeye salmon. In the first experiment, fish were collected by beach seine at Mosquito Point as they entered the Wood River lakes. During the season, 102 fish were anesthetized, measured twice, killed, and remeasured at intervals up to 36 hours after death to approximate conditions of fish in the canneries. The live measurements correspond to those taken at the sampling stations as the fish enter the lake systems.

Otoliths were also taken from the fish used in the Mosquito Point measurement experiment. The purposes of this collection are to compare the readability of otoliths taken from sockeye entering the lake system with the readability of those collected from spawned-out sockeye, and to determine if the otoliths degenerate after the adults enter fresh water.

The amount of food available to young sockeye salmon partly depends on the rate of food production at the base of the food chain. Measurements of primary production made in 1961 and 1962 indicated that the primary productivity rate is very similar in various lakes of the Wood River system. Measurement of primary productivity was continued in Lake Aleknagik in 1963 and 1964 to obtain a measure of annual variability: measurements were made by carbon 14 and chlorophyll methods at two stations. Each station was sampled once a month in July, August, and September. Alkalinity and pH were measured for water samples drawn at 5- and 15-m. depths on each carbon 14 run. A temperature profile, a vertical plankton haul, and a Secchi disk reading also were taken on each run. Daily weather data including incident light were recorded throughout the summer.

Sockeye growth and survival studies.—The March earthquake and resultant tidal waves caused heavy damage to the Alaska Department of Fish and Game's Kitoi Bay Research Station, near Kodiak. The

hatchery building, with over a million sockeye salmon fry, laboratory, and office were washed away. Other buildings including the generator shed were destroyed. Only the bunkhouse remained in usable condition. Smolt and adult holding and sampling facilities were heavily damaged.

The Department altered its plans for the 1964 field season because of the destruction of the research station and facilities. The fry introduction that had been planned for the Jennifer Lakes was postponed for a year. Some modification and reconstruction of smolt and adult facilities were undertaken, and smolt and adult sampling and counting were continued. The recovery of marked fish in the canneries was carried on also as planned. Some plankton studies were continued, although the experiments planned for the 1964 season to determine feeding preferences and habits of juvenile salmon in the rearing lakes were curtailed. Temporary living, storage, and laboratory facilities were erected and plans developed for rebuilding the station.

Contract Research

A substantial portion of the Federal research effort on salmon is contracted with S–K funds, primarily to FRI and to a lesser extent to the Alaska Department of Fish and Game. Research contracts with FRI are for research on the sockeye runs of the Nushagak and Kvichak systems in Bristol Bay and on the effects of logging on fish in streams of Southeastern Alaska. The State of Alaska is determining the effects of removing predators and competitors from small lakes used by sockeye salmon and then stocking the lakes with various densities of sockeye salmon.

Technical Advisory Services to Industry

Saltonstall–Kennedy funds have provided the services of a full–time food technologist to provide technical advisory services to the Alaska seafood industry.

Alaska shrimp processors keep their shrimp in ice before using a machine peeler, but the need for this practice has not been demonstrated. To study yield and quality changes in shrimp processed after varying periods of holding, a pilot experiment was made in cooperation with the Alaska Department of Health and Welfare. Four thousand pounds of pink shrimp were purchased from a shrimp boat about 12 hours after capture. The shrimp were divided into four lots and stored in ice. One lot was processed on each of the next four days to study changes in the shrimp products produced. Conclusions of this preliminary experiment indicate that "aging" improves machine peeling characteristics of Alaska pink shrimp but only at the expense of other quality factors.

It would be desirable to develop alternate processing techniques that would substitute some other procedure for the present holding.

Pacific

Progress was made on several problems. Efforts were made to determine the effect of processing on the quality of Dungeness crab and to develop a grade standard for fresh, dressed halibut. Other studies were made to obtain information for managing whale populations, to develop markets, and to learn if hake will support a commercial fishery. Attention was again given to fish passage at high dams and in large impoundments and to the collection of statistics. Details of these efforts follow.

Dungeness Crab Quality Studies

At the request of the Shellfish Committee of the National Fisheries Institute, Bureau technologists at Seattle, Wash., investigated the effect of processing on the quality of Dungeness crab meat. Brining, rinsing, and draining techniques during processing were important in the control of both quality and net weight of the product. For example, 15 minutes is optimum drain time before packing; longer draining results in greater deterioration during frozen storage and greater drip upon thawing.

Halibut Grading Program

Information was collected to form a basis for developing a grade standard for fresh, dressed halibut. The quality of the fish was determined at the time of landing and again after freezing and subsequent cold storage. These observations illustrated the importance of temperature and pH on quality of the product. A study was made on the chalky condition in halibut, which is an economic problem of the industry.

Marine Mammal Research

On three whale-marking cruises, paid for with S–K and regular Bureau funds, Bureau biologists marked 181 whales of five species. Capture of the marked whales will reveal their movements and intermingling in the North Pacific and will provide a scientific basis for managing whale populations.

Market Development

In the Pacific Northwest and Alaska, Bureau marketing specialists cooperated with manufacturers, suppliers, and potential users in developing plastic fish boxes for transporting fishery products. They cooperated also with packaging material manufacturers and retail meat de-

partment managers in developing prototypes of plastic packages for retailing fresh fish. Such packages will permit the fish to be displayed in ice without the package deteriorating. These marketing specialists also held merchandising clinics for retailers in Montana, Idaho, and Washington and for schools, at which purchasing, handling, nutrition, and menu planning were discussed before groups of dietetic interns. They also provided information and materials for the editor of a fishermen's publication for a series of cartoons and articles aimed at improving handling and sanitation aboard vessels and in plants. In addition, they held meetings with State purchasing agents and institutional buyers to acquaint them with the Bureau's lot inspection service as a means of ensuring quality.

Pacific Hake

Exploratory fishing and gear research indicates that hake will support a potential commercial fishery in the Northwest, and preliminary studies on processing meal and oil from hake have shown that the fishing industry can use this species. The Bureau has cooperated with industry in planning a reduction plant operation.

Salmon vs. Dams

The high, multiple purpose dams of the Northwest are an increasing threat to migrating salmon. An essential part of the research on problems of passage of salmon at dams on the Columbia River and its tributaries was conducted with S–K funds by the States of Oregon and Washington under contract to the Bureau's Fish–Passage Research Program.

Limnological studies by the Washington Department of Fisheries at Baker and Shannon Reservoirs on the Baker River and Merwin Reservoir on the Lewis River demonstrated that physical and chemical conditions are favorable for rearing juvenile salmon in all three reservoirs. Merwin Reservoir, however, contains large populations of predatory fish that limit production of salmonids in this Reservoir.

A floating apparatus to collect juvenile salmonids was tested at Merwin Reservoir by the Washington Department of Fisheries. Similar artificial outlets have been used successfully at Baker and Shannon Reservoirs where turbine intakes are at middepth and disrupt the surface water layers. In Merwin Reservoir high predation and an unbroken surface layer (due to deeply submerged intakes) resulted in lesser success than at Baker and Shannon Reservoirs.

Reservoirs under study by the Fish Commission of Oregon with S–K funds are North Fork, Pelton, and Round Butte. Conditions for passage of juveniles were good at North Fork, fair at Pelton, and poor at

Round Butte. Success in maintaining salmon runs above deep reservoirs was related to two main reservoir–connected phenomena: survival of young salmon up to the time of migration and survival of migrants during passage to the sea. Survival in North Fork was 8 percent and passage efficiency 70 to 90 percent. In Pelton Reservoir survival was less than 1 percent and passage efficiency 13 to 69 percent.

Microbiologists of the Fish Commission of Oregon studied salmon diseases in fish passage situations. Adult salmon produced a weak, demonstrable antibody after being injected with an antigen. Juvenile salmon were passively immunized with antisalmonicida–trout serum to challenge infections of *Aeromonas salmonicida*. Tests are still under way, but no effective, economically feasible means exist to control diseases affecting adult salmon during the prespawning period, with the possible exception of temperature control of water in holding ponds and the treatment of external fungus infections with malachite green.

Statistical Services

The statistical unit in Seattle, Wash., is concerned mainly with collecting and compiling annual fishery statistics on the commercial catch of fish and shellfish; the number of fishermen, vessels, boats, and gear in each fishery in Washington and Oregon; and the amount and wholesale value of all manufactured fishery products produced in the two States each year. Data on the annual catch of each species of fish and shellfish are obtained mostly from records of the State fishery departments and the International Pacific Halibut Commission. Values for the catch are obtained in part from State records and from many other sources. Special surveys were made to obtain data on manufactured fishery products, such as canned salmon and tuna, fresh and frozen fillets and steaks, shucked oysters, and other fishery products.

California

Studies were varied. Biologists observed the behavior of anchovies that were feeding on brine shrimp and developed serological and tagging methods for investigating the population structure of the northern anchovy. A cruise was made to find concentrations of hake. An important study covered fishery education and marketing. Studies were made on the abundance and distribution of rockfish of the California Current region. Euphausiid shrimp were studied to learn how carbon is transferred through the food chain. Most of the studies, however, concerned tunas. These included distribution of tunas in the eastern tropical Pacific and their relation to variations in the ocean environment, effect of the thermocline on success of tuna purse seining in the

eastern Pacific, completion of a hot-air balloon for a tuna spotting and oceanographic observation platform at sea and technology of tuna. Details of these studies follow.

Anchovy Research

Studies were made on the feeding behavior of the anchovy and the increased abundance of the northern anchovy.

The effect of school size on anchovy feeding behavior was studied by allowing groups of 1, 4, 16, and 64 fish to feed on an oversupply of brine shrimp for various time periods. Analysis showed that the amount of food consumed was independent of school size but varied with fish size. Feeding behavior depends on the size of the food particles. Schooling is abandoned and the fish go into a feeding frenzy when food is first encountered. If the food consists of brine shrimp larvae, the frenzy subsides quickly as the fish shift from a biting to a filtering type of feeding. If the food consists of adult brine shrimp, the frenzy and biting continue for a much longer time.

The spectacular increase in abundance of the northern anchovy (*Engraulis mordax*), observed on CalCOFI survey cruises, has focused interest on this species. Biologists developed serological and tagging methods to help study the population structure of the anchovy. By immunizing large fish with anchovy red cells, they are also developing reagents for the serological studies. As a result of a series of experiments on captive anchovies held in bait tanks, Bureau biologists have found that inserting a nickel-steel tag into the body cavity is a practical method of tagging the fish. The lowest mortality resulted when the tag was coated with an antibiotic (tetracycline) paste and inserted posteriorly through an incision in the abdominal wall. Fish tagged without being anesthetized survived better than the anesthetized ones; it appears also that newly caught anchovies had a higher survival than anchovies conditioned in bait tanks before tagging.

Hake Explorations

The vessels *Black Douglas* and *John N. Cobb* of the Bureau's Exploratory Fishing and Gear Research Base, Seattle, made a third cooperative pelagic survey cruise in February and March 1964 to locate concentrations of spawning hake and to collect spawning adults with a massive pelagic trawl. Spawning hake were taken in a number of hauls. The largest catch, 20,000 pounds, was made in an hour's fishing time, 35 miles west of San Diego. As larvae, hake have consistently been the second most abundant species in the California area surveys.

Market Development

Public service space for a Regional marketing exhibit was made available at the restaurant conventions of the Western Hotel & Motel Association, Southern California Restaurant Association, and the Colorado–Wyoming Restaurant Association.

Marketing programs were continued with the Adult Education Division of the Los Angeles City Department of Education. The Bureau, in cooperation with local trade associations, undertook market promotions in connection with "Fish 'n Seafood Parade," Lent, and canned shrimp and canned pink salmon.

Participation in school lunch workshops was stressed during the year. Fish cookery demonstrations and lectures were presented to school lunch personnel in Arizona, Utah, Colorado, and California. Bureau personnel, in cooperation with the Agricultural Extension Service, public utility firms, and mass media representatives presented material in Tucson, Eureka, and Reno on all phases of purchasing, handling, and preparing fishery products.

The program developed for the commissary school at the San Diego Navy Training Station was presented to each new class of students. Quantity fish cookery was demonstrated, and the role of fishery products in menu planning discussed. The same program was given at Camp Pendelton and the San Diego Marine Training Center.

Rockfish Studies

As part of a continuing study of fishes of the California Current region, Bureau scientists have given special attention to the commercially important rockfish. About 50 species live in California waters. Their larvae can be identified because they can be removed from known gravid females. It is, however, necessary to rear the larvae until the "larval" pigment pattern becomes established. The larvae can then be matched with similar sized rockfish larvae in CalCOFI collections, series established, and estimations made of distribution and relative abundance.

Shrimp (Euphausiid) Physiology

In a study of the transfer of carbon through the food chain from plankton to fish, an investigation was begun this year of the euphausiid shrimps which are an important group of fish food organisms. By maintaining these organisms in the laboratory, Bureau scientists have discovered that euphausiids molt as often as every 5 days and shed 10 percent of the dry weight at each molt. Calculated on the basis of the population in nature, one species, *Euphausia pacifica*, sheds as many

as 20 million tons of molts each over its geographical range. Molts may be an important food source for benthic organisms and other detrital feeders in the sea.

Tuna

Studies were made to learn more about four principal problems of the tuna industry.

Distribution and Ocean Environment

Investigations of the variations in the ocean environment and their relation to the distribution of tunas in the eastern tropical Pacific, were continued in 1964 under an S–K contract with the University of California, San Diego, and Scripps Institution of Oceanography, La Jolla, Calif. During this period a series of 10 papers, summarizing available information about the physical oceanography, biological oceanography, and tuna ecology of the entire region, was completed. A new study began on the detailed oceanography and ecology of tropical tunas in the region west of Baja California. The principal factors being investigated are temperature and tuna, herbivores, phytoplankton, and nutrients.

Purse Seine Success and the Thermocline

Available for a study of the effect of the thermocline on success of tuna purse seining in the eastern Pacific were 1,976 purse seine sets and their associated temperatures recorded by bathythermograph equipment attached to the seines. The percentage of successful purse seine sets was considerably higher in areas where the thermocline occurred near the surface and had a sharp temperature gradient.

Spotting from Balloons

A project demonstrating the feasibility of using a hot–air balloon for a tuna spotting and oceanographic observation platform at sea was completed with the assistance of the Bureau's Oceanographic Instrumentation Program, Washington, D.C. The work was conducted by the staff of the Tuna Resources Laboratory, La Jolla, Calif. The first phase of the work was completed in 1964. Additional work may be done.

Technology

A new tuna technology program began in 1964. Need for this work has resulted from changed fishing methods and handling and preservation practices aboard tuna vessels. In the past, most tuna were caught individually by hook and line and were handled rapidly and frozen quickly. The modern method is to use purse seines, which take large numbers of tuna at one time, resulting in slower handling and more gradual freezing.

Work on tuna technology at Terminal Island will emphasize various aspects of raw fish quality between the time of capture at sea and landing at the shore canneries. A contract for preliminary investigations into tuna quality with respect to color changes in the flesh between the time of capture at sea and the time of processing at the shore cannery was the first step in this research program and is nearing completion. At the laboratory, work is in progress to study quality in canned tuna to provide bases for assessing quality improvements.

Gulf and South Atlantic

Continued progress was achieved in this region. Standards were drafted for frozen raw breaded shrimp and for composition of canned shrimp. A code was prepared for processing procedures. Another activity was promotion of fishery products. Studies were made also to learn the cause of the sharp decline in menhaden abundance and to control two micro-organisms, one causing certain food poisoning outbreaks and the other contaminating fish meal. Other activities were investigating the size of the shad populations supporting the commercial fisheries, studying the reaction of shrimp to electrical stimulus, collecting shrimp fishery statistics, studying how postlarval and juvenile shrimp adapt to the estuarine habitat, and discovering shrimp parasites. These projects are discussed below.

Fishery Standards

The Bureau continued to formulate standards to improve quality. Technologists at the Bureau's Technological Laboratory, Pascagoula, Miss., drafted the final revision of the Frozen Raw Breaded Shrimp Standard, which specifies a more uniformly high-quality product. They discussed the revision with the industry before its publication as a proposed rule in the Federal Register. Interest in international standards resulted in the Bureau's drafting also a standard of composition for canned shrimp and a code for processing practices. The Bureau is also developing "Country of Origin Standards" for various fishery products under the guidance of the Codex Alimentarius Commission of the U.N. Food and Agriculture Organization.

Market Development

An aggressive approach was taken to promote fishery products. Special emphasis resulted in the successful promotion of oysters, pink salmon (part of national program), Spanish mackerel, and smoked fish products. Fish cookery demonstrations were presented to 35 groups of Agriculture Extension Service and school lunch personnel. Similar type

demonstrations were taped for television release. The Florida State Board of Conservation contributed $15,000 in a cooperative effort with the Bureau to promote Florida seafoods. Marketing assistance was given to new and developing fisheries: the swordfish fishery in North Carolina and the royal red shrimp fishery in Georgia and Florida.

Menhaden Research

Research of the Bureau's Biological Laboratory, Beaufort, N.C., into the reasons for the sharp decline in abundance of menhaden in the Middle Atlantic covers many aspects. The analysis of daily vessel landings and sampling of purse seine catches led to a contract for transferring all logbook data for 1955–63 to automatic data processing cards. Infrared airborne radiometry measured the sea surface temperatures along the Atlantic Coast from Cape Hatteras to Cape Fear each month in cooperation with the U.S. Coast Guard. Seabed drifters and drift bottles furnished by Woods Hole Oceanographic Institution were released to obtain information on water currents. The effects of minimum temperature on the survival of larval menhaden were also studied; larvae acclimated to cooler temperatures generally survived longer than those acclimated to warmer temperatures, but larval size and survival time were not related. Thermographs have been placed in estuaries to record the water temperatures during entry and residence of menhaden larvae in the nursery area. Population studies of the Atlantic menhaden will ultimately require some direct evidence from tagging and recovery, and preliminary studies of methods and equipment for this purpose have been undertaken.

Microbiological Studies

Emphasis in microbiological research at the Bureau's Technological Laboratory, Pascagoula, Miss., was on studies of *Clostridium botulinum* type E, which has caused certain food poisoning outbreaks. Basic nutritional studies on strain D8 of the organism have been completed through the determinations of spore germination times and growth curves as influenced by adding selected acids to synthetic media. Much interest has been shown in an experiment in which additions of citric or lactic acids permitted toxin to be produced in a synthetic medium. Groundwork has been laid for a survey of the presence of *C. botulinum* type E in the estuarine waters of the Gulf and South Atlantic area.

Studies were made on the occurrence of *Salmonella* in fish meal and the means of preventing such contamination. Sanitation guidelines were developed in concert with other Federal agencies and the menhaden industry.

Shad

Scientists at the Bureau's Biological Laboratory, Beaufort, N.C., continued studying the Atlantic shad fishery. Using catch–effort statistics, they completed inventories of the shad populations supporting commercial fisheries in York River, Va., Cape Fear River, N.C., and St. Johns River, Fla. They found the commercial catch in York and Cape Fear Rivers and the sport catch in the St. Johns River had increased.

Shrimp

The studies on shrimp were made by biologists and fishing gear experts, who reported progress on four projects.

Behavior

To improve the productivity of Gulf of Mexico shrimp vessels, studies have been made on the behavior of shrimp and their reaction to electrical stimulus. An electric shrimp trawl was designed, constructed, and tested at the Bureau Gear Research Station, Panama City, Fla. Under daylight conditions the effectiveness of this gear has been good to poor. On soft bottom, as in the Mississippi Delta area, the shrimp respond extremely well to the electrical stimulus; however, on hard bottom, as in the Tortugas grounds, they respond weakly. Complex underwater camera and television equipment have also been designed to record and to permit observation of the effectiveness of the gear.

Fishery Statistics

Collection and publication of detailed statistics on the shrimp fishery of the Gulf States continued. Monthly and annual tabulations show the volume and value of the catch by species, depth range, and geographical location. This information on the Nation's most valuable commercial fishery is indispensable to biologists and to the shrimp industry.

Life History (Early)

Scientists at the Bureau's Biological Laboratory, Galveston, Tex., studied how postlarval and juvenile shrimp adapt to the dynamic estuarine habitat. The three commercially important species of shrimp in the Gulf of Mexico spend a good portion of their lives in estuarine waters. A growth and survival experiment under controlled conditions in which young white and brown shrimp were held at known levels of temperature and salinity yielded the first measurements of how they respond to variations of the two factors. The results suggest that the two species may have significant differences in their ecological requirements. Seasonal dissimilarities in the occurrence and abundance of these shrimp in Gulf estuaries may have a physiological basis. Laboratory

tests show that temperature has a much more dramatic effect on the growth of postlarval brown shrimp than does salinity.

Parasite

The discovery of a parasite of the shrimp has provided a new lead on natural predation on shrimp. A tapeworm parasite of common brown and white shrimp in Galveston Bay has been found in one of the common fishes of that area. To what degree the fish prey on shrimp may be gaged by the relative abundance of the worm.

North Atlantic

As befits a region with many interests, the Bureau was active in many fields. Studies were made of young Atlantic herring, bottom fauna of the Atlantic Continental Shelf and Slope, electrical trawling tests, fishing gear materials methods and design, fishing gear observation and instrumentation, and a fishing vessel safety program was advanced. Other activities included a study of haddock abundance, fish cookery demonstrations, fish and lemon promotion, fish promotion at the Hilton Hotels, and use of radio and television time for advertising fish. Still other activities included determination of the nutritive value of fishery products, studies of culture of food for bivalves, mollusk diseases, oyster culture and mortality, shellfish predators, standards and specifications research and development, and escapement of whiting from trawls. A summary of these activities is given below.

Atlantic Herring (Young)

A method of determining the abundance of herring prior to recruitment to the Maine sardine fishery would provide the fishing industry with information upon which to base its annual fishing and canning operations. Along the Gulf of Maine Coast, herring hatch in the fall and are large enough to be canned 1 year later. To determine their abundance during the precanning period requires a capability to capture efficiently the various sizes of small herring. When this capability is attained, a sampling program will be designed to provide information from which estimates of abundance can be made. Such a program is necessarily based on a prior knowledge of the seasonal and areal distribution of the fish.

High-speed sampling gears, tested in 1964, efficiently caught larval herring. Sampling with these gears has provided a description of the seasonal and areal distribution along the Coast of herring larvae, from hatching to metamorphosis.

Water leaving the deep estuaries along the Gulf of Maine Coast mixes with water beyond the headlands so that changes in the physical environment are sometimes difficult to determine precisely. For this reason, special emphasis has been given to studying biological indicators among the minute animals (zooplankton) in the sea.

Studies of both herring and zooplankton are supported by physical hydrographic measurements of water temperature, salinity, transparency, and currents. Time series data were collected at 10 inshore stations and quasi-synoptic data at 21 alongshore stations. Sufficient material now exists to describe generally the seasonal and areal changes in physical oceanic conditions along the Coast.

Bottom Fauna Studies

In the primary phase of their study of the bottom fauna of the Atlantic Continental Shelf and Slope, biologists of the Bureau's Biological Laboratory, Woods Hole, Mass., sorted, grossly identified, counted, and weighed quantitative samples collected by R/V *Gosnold*. They made an effort to process these samples quickly to prevent decalcification in organisms with small or thin calcareous bodies. About one thousand samples were processed during 1964. Also benefiting from these specimens are 31 biologists at universities and scientific laboratories in the United States and abroad who are studying this material. Tens of thousands of preserved specimens have been sent to specialists for identification. The abundance and types of bottom organisms are important factors in the ecology of the fishing banks.

Electrical Trawling Tests

Tests of experimental electrical fishing gear developed by the Smith Research and Development Company, Lewes, Del., were made during five cruises of the *Delaware*, the research vessel of the Bureau's exploratory fishing base in Gloucester, Mass. The electric field was used at the mouth of an otter trawl as an adjunct to the net for catching fish. On the first cruise, the total catch of the net with the electric field was about double the catch of the net without the field.

During subsequent cruises, efforts were made to (1) reduce the electrical power requirements, (2) determine whether the electric field could be used to catch only certain sizes of fish, and (3) study how fish react to the electric field and film these observations, which are obtained by underwater television. A decrease in the power used correspondingly reduced the range of the electric field and the effectiveness of the field for catching fish; however, it may be possible to use electrical techniques that reduce the amount of power needed without materially changing the field range. Lessened power requirements will re-

duce the eventual cost of the equipment to the fishermen. Efforts to determine fish–size selectivity were largely unsuccessful because the pulse generating unit had technical limitations. As a result of the underwater television study of fish reaction the electrical components on the net were modified and small fish were seen escaping from the field. The escape of these fish indicates that electrical fishing may be useful as a conservation measure.

Fishing Gear

Fishing gear studies consisted of off–the–bottom trawling and use of instruments to show how gear performs while it fishes.

Materials Methods and Design

Industry needs new or modified methods for more effective use of existing gear. Interest in off–the–bottom trawling was a natural consequence of this need, because many now unfished areas could be fished if a trawl could be towed near the bottom but still above the rocks. Two cruises of the *Delaware* tested how various nets perform when fished with the doors on the bottom and the net floated above the bottom. The results indicate that in the New England area the bottom not now being fished is generally so irregular and precipitous that the net is caught upon high peaks and torn whenever it is fished near enough to the bottom to catch fish effectively.

Observation and Instrumentation

A great need exists for knowledge of how gear performs while it fishes and how modifications may affect its performance. To fill this need, the Exploratory Fishing and Gear Research Base at Gloucester, Mass., has developed an all–sonic transducer system for making linear measurements of trawl nets while they are fishing. Continuous recordings on an echo–sounder recorder simultaneously show the distance between the doors, the distance between the end of the wings of the net, and height (above the bottom) of the center of the headrope. As an accessory to the system, a bottom contact indicator immediately signals whenever the footrope loses contact with the bottom. Other information can be taken as needed by the additional use of specific instruments, such as odometers, strain gages, and thermometers. A *Delaware* cruise made a final check of this system before the developmental work ended; the system is now a practical and useful tool available whenever needed.

Fishing Vessel Safety Program

Continued emphasis was placed on promoting vessel safety. In cooperation with the Gloucester Mass., Fire Department, the Bureau

inspected the fire protection equipment on 37 fishing vessels. A list of deficiencies and recommendations for corrective measures was given to each vessel owner. Over 300 copies of the Fishing Vessel Safety Manual were distributed to insurance companies and vessel owners. Material on selected marine safety subjects affecting commercial fishing operations was prepared for radio stations and news media. In cooperation with industry the Bureau demonstrated the approved marine safety equipment for commercial fishing vessels. The increase in the number and quality of safety devices installed by the fleet indicates that vessel owners are aware of the importance of safety. Inflatable life rafts on a Gloucester fishing trawler were instrumental in saving the lives of seven crew members when the vessel foundered and severe weather prevented the launching of conventional type lifeboats. Trainees in an On–the–Job Training Program for commercial fishermen were instructed in fishing vessel safety practices prior to embarking on their initial fishing voyages. All trainees completed the 16–week course without personal injury. During 1964 substantial reductions were made in hull insurance as well as in protection and indemnity insurance premiums for certain New Bedford fishing vessels, indicating that safety standards and accident experience have shown marked improvement.

Haddock Abundance

Studies on estimating sustainable yields of haddock on Georges Bank have become more important now that Canada and the U.S.S.R. have increased their fishing for haddock and have raised the catch to 140 million pounds in 1964—a 40 percent increase since 1961. Examination of catch and effort statistics of the U.S. haddock fleet since 1917, when otter trawlers were just becoming important, indicates that fishing has reduced the abundance from a level of 30,000 to 40,000 pounds per day in 1917–21 to a level of 9,000 to 15,000 pounds per day in recent years. The average annual total catch and effort in the early period was 50 to 70 million pounds and 2,000 to 3,000 days. Since World War II the annual total catch and effort have averaged 95 million pounds and 7,000 to 8,000 days. The studies indicate that these latter figures correspond closely to the annual sustainable maximum yield point. Studies are continuing to clarify the population processes that control production and abundance.

Market Development

The market development program included fish cookery demonstrations, promotion of fish and lemons, promotion of fish at the Hilton Hotels, and radio and television time used by marketing personnel.

Fish Cookery

The home economics fish cookery demonstration program has effectively stimulated the use of fishery products at both institutional and household consumer levels. During 1964, about 3,135 school lunch and institutional personnel, extension specialists, college and university students, and homemakers in 12 States and the District of Columbia attended 65 fish cookery demonstrations in the North Atlantic Region.

Fish and Lemon Promotion

A Bureau marketing representative from the North Atlantic Region and a Boston merchandiser for Sunkist Growers, Inc. made a joint presentation in Chicago at a meeting for all Sunkist merchandisers in the United States and Canada. The presentation pointed out methods by which lemons and fishery products could be promoted together successfully with mutual benefit to Sunkist and the fishing industry. As a direct result of this work with Sunkist, lemon and fish tie–in publicity has been generated across the country on a continuing basis via national magazines, retail market material, and recipes.

Fish Promotion at Hilton Hotels

Marketing personnel worked with representatives of the Hilton Hotel group and the New England fishing industry in planning a promotion of fishery products in all Hilton Hotels throughout the Northeast. Special color menus, table tents, and wine lists publicizing the New England fishing industry were furnished to Hilton Hotels at industry expense. The Hilton Hotels in return featured fishery products from New England.

Radio and Television Time

Because of the importance and growth of radio and television media in the northeastern United States, marketing personnel in the North Atlantic region have increased their attention toward this vital area. During 1964, marketing personnel arranged for 73 radio and television programs that accounted for over 20 hours of broadcast time. These programs were of a public service nature; however, at current advertising rates, the total time was valued at over $38,270 to the fishing industry. As a part of its cooperative, interregional efforts, marketing personnel also conducted 115 radio and 8 television programs in the State of North Carolina during 1964. This was made possible by the use of audio and audiovisual tapes.

Nutritive Value of Fishery Products

Comparatively little information is available on the nutritive quality of fish in the various forms in which it is consumed and none is avail-

able on new forms being developed. Dietitians, nutritionists, and physicians need this information, which will lead to increased acceptance and use of fish and fishery products. The Bureau's Technological Laboratory, College Park, Md., is studying the nutritive value of fish fillets and shellfish prepared by various means including frying, broiling, baking, and boiling. The nutritive value of raw shellfish also will be evaluated.

A comprehensive literature review has been made on how protein and amino acids affect hunger and satiety. This review shows that it is not clear whether fish and fishery products do or do not satisfy hunger as well as other forms of animal protein.

A new fishery product of almost unlimited commercial value is fish protein concentrate (FPC). Evaluation of many samples of FPC produced at College Park and at outside sources has shown that FPC produced at this Laboratory can be as nutritive as whole eggs.

Shellfish Studies

The shellfish studies included bivalve food culture, mollusk diseases, oyster culture and mortality, and predator research.

Culture of Food for Bivalves

The culture of large volumes of marine algae for food for oysters and clams is a central problem in planning and executing a commercial shellfish hatchery operation. The mass cultures of various algal species at the Bureau's Biological Laboratory, Milford, Conn., are used for experimental studies and starter cultures for other laboratories and commercial enterprises interested in shellfish culture. The biologists continue to develop methods to improve the culture yields and the efficiency of procedures used for maintenance. They are also exploring the possibility of concentrating and stockpiling algal foods that can be used when shellfish cultivation is intensive. In addition, they are studying how to use artificial salt mixtures instead of natural sea water. Finding nutritional balances for optimum algal growth is a complex procedure that varies with the individual species. Other studies concern the tolerance of algae to environmental changes; that is, how antibiotics, acidity, and alkalinity affect the algae. The biologists have completed their studies on how detergents affect algal growth.

Mollusk Diseases

During the past 3 years a group of bacteria has been isolated and identified as responsible for a hatchery disease of larval and juvenile shellfish, particularly American oysters and quahogs. This disease has been designated "bacillary necrosis." The disease was studied by ex-

amining tissues of infected larvae at hourly intervals after experimental infection; the disease was confirmed to be a highly invasive, necrotic infection. Bacterial "swarming" around infected larvae is a characteristic sign of this disease. Larvae, when examined microscopically, appear surrounded by a cloud of hundreds of thousands of highly motile bacteria that ultimately consume the larvae and leave only empty shells. Studying the normal histological embryology of bivalves prior to setting is necessary to understand the pathological changes in larval tissues. The day–by–day development of hard clam larvae, from the egg through the first week of life, was determined by histological sectioning.

Large numbers of marine bacteria from plant and animal life in Long Island Sound appeared similar to the Milford Shellfish pathogens and were inoculated into healthy cultures of hard clam larvae. None of these bacteria killed the larvae and may possibly be new species.

Oyster Culture

Studies of shellfish culture are directed toward assessing oyster productivity and recruitment in local natural waters, developing commercially feasible techniques of shellfish husbandry, and developing and evaluating cultural methods in artificial salt–water ponds.

During 1964 monitoring stations were expanded to include most local areas. Weekly fluctuations in oyster setting were observed by exposing asbestos flexboard panels, and seasonal setting was evaluated on bags of shell. Late in 1964 four ¼–acre artificial salt–water ponds were established at the Bureau's Biological Laboratory, Oxford, Md. Two major studies were begun on (1) the growth and survival of seven different strains of seed oysters in an artificial pond and (2) the growth, condition, and survival of oysters on different types of bottoms (clay, sand, shells, and polyethylene film).

A pilot operation tested the commercial feasibility of growing suspended oysters in a natural tidal pond. A framework measuring 108 feet by 12 feet was built over the pond, and over one thousand strings of seed oysters were suspended from it. Experiments have shown that suspended oysters are of high quality and reach marketable size sooner than natural stocks. Intensive oyster culture of this type could be particularly important for areas generally considered nonproductive of commercially important shellfish.

Oyster Mortality

A study of the mortality of oysters was begun at the Bureau's Biological Laboratory, Boothbay Harbor, Maine, and transferred to Oxford, Md., several years ago. The work has two principal orientations: (1) development of tissue culture techniques for studies of viruses and

other microbial pathogens of oysters and (2) exploration of serological and related techniques to distinguish diseased from normal oysters. Some progress has been made in both areas. While true long-term culture of oyster cells has not been possible, tissues can be maintained for long periods, which suggests that Bureau scientists are near true culture. Geographic groups of oysters have been demonstrated by electrophoretic separations of oyster serum components, particularly enzymes, and this suggests that serology is sufficiently precise to be of eventual use as a diagnostic tool in recognizing diseased stocks and possibly in characterizing resistant stocks.

Predator Research

During the past several years biologists at the Bureau's Biological Laboratory, Milford, Conn., have been working on chemical control of oyster drills, *Urosalpinx cinerea* and *Eupleura caudata*. The method consists of covering the bottom of shellfish beds with a thin layer of sand treated with Polystream (a mixture of chlorinated benzenes). From 1960 to 1962 field tests on beds as large as 30 acres showed that the method effectively controlled oyster drills. In March 1964 the Pesticide Regulation Division, U.S. Department of Agriculture, renewed the 12-month experimental permit that allows the shellfish industry to use this treatment under supervision of State or Federal research personnel. About 400 acres of oyster grounds were treated during the summer of 1964.

Several thousand bushels of shells were also treated with Polystream by the oyster industry. Counts of oyster set on treated and untreated shells varied to some extent, depending on the area. On beds where fouling of untreated shells was heavy, the treated shells collected more than twice as many oyster set as the untreated shells. When fouling was very light, however, untreated shells collected slightly more oyster set than treated shells.

A new product, consisting of clay granules containing about 40 percent Polystream, was introduced during the summer of 1964 as a possible substitute for the Polystream/sand mixture. From small-scale testing, this material, called "Granular Polystream," appears to control oyster drills as effectively as the mixture of Polystream and sand.

Standards and Specifications Research and Development

The Bureau's Standards and Specifications Research and Development Program involves the development of USDI Grade Standards used in voluntary inspection of seafoods program. During 1964, one revised standard was published and developmental work begun on another. To assist in the uniform application of Grade Standards,

Inspectors' Instructions were also published for four other standards. Development of Federal and NASPO (National Association of State Purchasing Officials) Specifications is also carried out under this program. During 1964, two proposed interim Federal and six proposed Federal specifications were developed. Work was also carried out on two NASPO specifications.

Two grading surveys of frozen retail fishery products were completed during 1964. These surveys are designed to provide the fishing industry with (1) the latest information on the quality of frozen fishery products, (2) information that tells the processors where quality loss takes place, and (3) a yardstick to measure progress.

As part of the research with the Standards Program, a study began on how processing variables affect the fish flesh content of breaded portions. During 1964 the first phase, which was concerned with the effect of temperature of fish blocks on fish content of breaded portions, was completed.

Studies on the identification of species were also continued in an effort to devise a rapid and simple method that could be used in the field. The adoption of the cellulose acetate strip electrophoresis technique will provide industry with a practical method of positively identifying the species of fish in raw materials, such as fish blocks, to assure compliance with mandatory labeling regulations.

Whiting Escapement from Trawls

The Bureau's Exploratory Fishing and Gear Research Base, Gloucester, Mass., and the Bureau's Biological Laboratory, Woods Hole, Mass., made studies of whiting escapement through various trawl mesh sizes. Such studies are necessary for satisfactorily and equitably managing the fishery resources. The specific purpose was to determine how the catch of whiting is affected by having 3– and 2–inch (internal stretched mesh) mesh sizes in the bag (cod end) of the net. Both nylon and cotton whiting nets were used with different sizes of cod ends.

Great Lakes and Central Region

S–K funds were used advantageously in the Great Lakes and Central Region. Bureau scientists studied the environment of Lakes Erie and Ontario. In southern Lake Michigan explorations were made to determine seasonal location, abundance, and availability to bottom trawls of alewife and bloater chub populations. Scientists evaluated also the lake trout–sea lamprey relation in Lake Superior. Market development activities were intensified. Greater efforts were made to develop and expand markets for Great Lakes–produced fish. Statistical services

were continued. Assistance was given the fishing industry to block spawning alewives with an air-bubble curtain. Technologists investigated fish antimetabolites and industrial products of the fisheries. Details of these activities follow.

Environmental Research

Chemical analyses of water samples collected during a comprehensive limnological survey of Lake Ontario show that concentrations of calcium, sodium, and potassium are similar to those of Lake Erie. Dissolved oxygen was near saturation in all areas and at all depths except the bottom waters at two stations near the St. Lawrence River where saturation was less than 50 and 30 percent, respectively. Lake Ontario appears to have large populations of mysids and amphipods, abundant plankton, but few fish.

Based on drift bottles released in 1963, analysis of the seasonal current patterns of Lake Erie shows that the surface current direction was influenced greatly by wind: currents were completely reversed by a reversal in wind direction. The major portion of the Detroit River flows as a distinct unit through a rather narrow portion of the western basin.

Fishery Explorations

Surveys on the alewife and bloater chub populations in southern Lake Michigan revealed that during this 3-year study, catches by the R/V *Kaho* of these two abundant and underutilized species clearly demonstrated a potential annual production rate of at least 100 million pounds —an amount well over the total U.S. production of all species in all of the Great Lakes up to the present time.

Certain segments of the commercial fishing industry, influenced by the findings of Bureau explorations, established two fish reduction plants in the State of Wisconsin. Although these high-capacity plants were operated only a short time late in the year, they helped to more than double Lake Michigan alewife production from about 5 million pounds in 1963 to about 11.5 million pounds in 1964. Pet food manufacturers also markedly increased their use of the alewives in 1964.

Lake Trout

Evaluation of the lake trout–sea lamprey relation in Lake Superior was continued with the sampling of lake trout in Michigan waters by commercial operators under direct supervision of the Bureau. A statistically reliable sample of 22,000 legal-sized lake trout was recommended; the actual catch was 20,927 fish, weighing 65,568 pounds.

Of these, 17,264 fish, weighing 53,002 pounds, were taken from different stocks occupying four offshore areas. Information from the research sampling showed that the incidence of lamprey wounds and scars was higher in the spring, substantially lower in September, and slightly higher in late fall and winter than in 1963. The average weight of legal fish continued to increase in 1964 to slightly over 3 pounds dressed; the percentage of hatchery–reared, fin–clipped fish in the catch from inshore waters reached 65.9 percent of the legal and 96.6 percent of the undersized fish, but in offshore waters only 0.2 percent of the legal fish were fin clipped. In September, 113 mature female lake trout were taken, about twice the number taken in the same month in 1963, and 14 percent of these were fin clipped.

Market Development

The heavily populated Great Lakes and Central Region had a continued intensive consumer education program. The marketing staff made 226 presentations in 16 Great Lakes States and Central States to stimulate the use of fishery products at the institutional and homemaker levels. This included over 30 hours of public service time on television and radio. The commercial value of this public service time is conservatively estimated at $150,000. Major newspaper food columnists in the area devoted about 16,000 column inches to Bureau consumer education materials—this newspaper space is worth over $130,000. Major newspapers devoted full–page spreads to Bureau consumer education materials, thus attesting to the high quality of these materials. Several articles were prepared also for trade journals and magazines to stimulate use of fish by the mass feeding industry.

Efforts to develop and expand markets for Great Lakes–produced fish were intensified to assist the economic rehabilitation of the depressed inland fisheries industry. Because of the changed character of the Great Lakes resource—the decline of the choice species and the increase of less desired species, some of which can only be used for industrial purposes—emphasis centered on developing and expanding pet food, mink feed, and other industrial-use markets. To illustrate the result of these efforts, the production of alewives and bloater chubs in Lake Michigan increased from a few thousand pounds annually as recently as 4 years ago to 11.5 million pounds in 1964. Industrial use of these species is expected to more than double in 1965. A number of large companies are investigating the possibility of establishing pet food processing and fish meal plants in the Great Lakes area.

The Bureau is also assisting the fishing industry in expanding human food markets for abundant Great Lakes fish, such as the chub and cisco. The marketing staff, for example, arranged for consumer ac-

ceptance tests for new products; that is, breaded whitefish, chub fillets, and boil-in-the-bag cisco fillets, developed by Bureau technologists. These tests were conducted in cooperation with extension service and professional market researchers at universities and indicate that these products show promise of consumer acceptance. Test results have been made available to industry.

Statistical Services

The automatic data processing tabulator unit was speeded up and a reproducer purchased to increase the efficiency and capacity of the unit. These actions will permit more expeditious processing of the ever-increasing volume of research and statistical data, and, consequently, will permit more timely use and application of research results.

The Bureau also helped the inland States refine and expand their statistical reporting systems to obtain more precise and comprehensive data on inland water fisheries.

A comprehensive historical review of the Great Lakes fisheries was prepared for inclusion in the historical section of the forthcoming annual issue of the Bureau's Statistical Digest.

Data on catch, value, and operating units were compiled for the eight Great Lakes States and for 21 States located within the Mississippi River drainage basin. Statistics for the Mississippi River drainage are being tabulated by specific water area rather than by major drainages as has been done previously, and this will make statistical information much more useful to researchers of resource problems in this area.

Wholesale fishery establishments in 21 inland States were canvassed to determine products handled, employment, and production of processed fishery products. Pet food manufacturers in the inland States were surveyed to determine the extent of fish use in canned pet food products. Collection of monthly fish meal and oil production data was instituted for two new fish meal plants operating in Wisconsin.

Technical Assistance to Industry—Fish Harvesting

Under a Bureau-State-city-fishing industry cooperative agreement, Bureau scientists demonstrated the feasibility of blocking the spawning migration of alewife with air-bubble curtains in the harbor at Milwaukee, Wis. A practical system is being developed to harvest alewife under similar conditions for the benefit of fish producers and for harbor managers who are faced with serious pollution control problems caused by large numbers of dead fish from the exploding Lake Michigan alewife population. Technical information and services were given to Lake

Michigan commercial fishermen who are changing their fishing methods to catch alewife and bloater chub more economically and in larger quantities.

Technical Research in Antimetabolites

Research on thiaminase, an anti–vitamin B_1 factor contained in many species of fresh–water fish, is continuing. Such fish, when fed raw to animals, produce a vitamin deficiency called Chastek paralysis, greatly feared by mink ranchers. Thus, a large potential market for these underutilized species is not being served. Research accomplishments during 1964 saw the near completion of heat inactivation studies on the thiaminase contained in various species of fish. Time–temperature relations indicate that processing whole fish for at least 5 minutes at 180° F. will inactivate this antimetabolite in all species studied.

Technological Research in Industrial Products

Experimental reduction tests have been carried out by using a reduction process under development at the Bureau's Technological Laboratory, Ann Arbor, Mich. Technologists made and evaluated pilot press–cake products, designed to increase the use of rough, thiaminase–containing fish. Cooperative feeding tests with U.S. Department of Agriculture fur animal researchers indicate that mink fed on a press–cake product made from fresh–water alewife produced as many kits and grew at almost the same rate as mink fed on a control diet.

General

These activities include audiovisual services, foreign fishery studies, home economics research, and national marketing services. A summary of these activities follows.

Audiovisual Services

One film was of particular interest. The motion picture, "Watermen of Chesapeake," produced by the Bureau in 1963 for the States of Maryland and Virginia, was distributed through the Bureau's 200–film library system. A diploma in recognition of the excellence of this film was received from the San Francisco International Film Festival, 1964.

Foreign Fishery Studies

Reports were prepared on foreign fishery developments in the Sino–Soviet bloc based on information obtained from original Soviet sources and from air surveillance flights by the U.S. Coast Guard, in cooperation with the Bureau, of foreign fishing activities off the U.S. coasts.

The collection of background information on the fisheries of Communist China was begun. Such information will be of value because of the expected increase in its high-seas fishing operations.

Home Economics Research

The 1964 home economics research program at the Bureau's National Home Economics Research Center, College Park, Md., included studies to determine the cost, quality, yield, and methods of preparation of selected fishery products for use in special promotions, school lunch, institutions, and as convenience foods. The results of this research were used in about 608,000 copies of consumer education material prepared and distributed by the Bureau.

Home economists made 1,147 palatability tests, 747 yields tests, 47 preliminary recipe tests, and 21 miscellaneous tests on fishery products cookery. A total of 440 recipes and supporting background materials were developed for use by the National Marketing Services Office in connection with nine industry-Government market promotion efforts.

During 1964, the National Home Economics Research Center provided 75 recipes, information on fishery products for use in the USDA's "Food Buying Guide for Type A School Lunches," and "Quantity Recipes for Type A School Lunches." These publications are used in school lunch programs throughout the Nation. Information was also furnished USDA for the publication "Family Fare," which is widely used by the Extension Service. In 1964, 11,321,000 copies of this publication were distributed. The National Home Economics Research Center also furnished considerable information on fishery products for a publication by the American Home Economics Association, entitled "Handbook of Food Preparation." Over 100,000 copies of this book have been printed. It is used widely in colleges and universities as a reference and working tool in food preparation classes.

Home economists presented 226 fish cookery demonstrations which included 42 for school lunch programs, 9 for feeding institutions, 50 for Agricultural Extension Service home economists, 105 for television, and 14 for other organizations. They also were guests on 9 radio programs, made 17 presentations to feeding industry groups, and participated in 5 fishery educational exhibits sponsored by the Bureau at State and national conventions. The registration for these conventions was about 72,000 home economists, dietitians, and restaurant personnel from all 50 States.

In addition to the color publications, other releases were developed and distributed on a limited basis to all media and selected mass food service operators. An outdoor fish cookery circular was released to consumers in quantity through the U.S. Fish and Wildlife Service's

Education Services. NMSO (National Marketing Services Office) developed a one–hour slide presentation (152 slides) "Fish Go in Schools" for initial use at the National School Food Service Convention. This presentation is being used to great advantage in the Bureau's school lunch program. Two handout publications have been developed for use with the presentation.

The Bureau received coverage of its newspaper materials in over one thousand newspapers during 1964. Consumer exposure through this coverage is estimated to be in excess of 100 million people. The excellent usage of Bureau materials in 1964 is, in great part, a result of the increased quality of the materials developed.

National Marketing Services

During 1964 the Bureau's NMSO at Chicago, Ill., considerably broadened its development program. For the first time, full–color booklets were developed and released on a cooperative basis with industry associations and State government agencies. More than 250,000 copies of industry–Government market promotion materials were printed and distributed. The work at NMSO is carried out in conjunction with the Bureau's National Home Economics Research Center.

The first color publication developed was in cooperation with the National Shrimp Canners Association. This publication, " 'Can–venient' Ways with Shrimp," was put to excellent use by both industry and the Bureau. The second color publication, "Fish Recipes from the Great Lakes," was developed as a Government Printing Office sales document for consumers, and was also made available to industry at cost. The third color publication, "Florida Fish Recipes," was developed in cooperation with the Florida Board of Conservation and the Southeastern Fisheries Association for distribution by both cooperators in early 1965. Color transparencies and black and white photographs were released nationally to food editors with the booklets.

Allocations of Saltonstall–Kennedy Act funds, fiscal years 1963–64

Program	1963	1964
	Dollars	*Dollars*
Biological research on fish and fisheries:		
Coastal and offshore research	2,084,900	2,137,200
Inland commercial fisheries research	170,400	162,500
Commercial shellfisheries research	287,000	259,600
Total	2,542,300	2,559,300
Research on fish migration over dams:		
Columbia River fish passage program	250,000	250,000
Total	250,000	250,000
Exploration, development, and utilization of commercial fisheries resources:		
Economic studies	133,000	126,500
Exploratory fishing and gear research	360,600	416,900
Market News reporting	37,000	37,000
Fisheries statistics	307,300	316,200
Food science and technology	459,200	517,700
Marketing	604,400	679,200
Foreign fisheries and trade	29,800	.....
Total	1,931,300	2,093,500
Administrative expenses:		
General administration	376,400	391,900
American Fisheries Advisory Committee	35,000	36,000
Total	411,400	427,900
Total program allocations	5,135,000	5,330,700

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